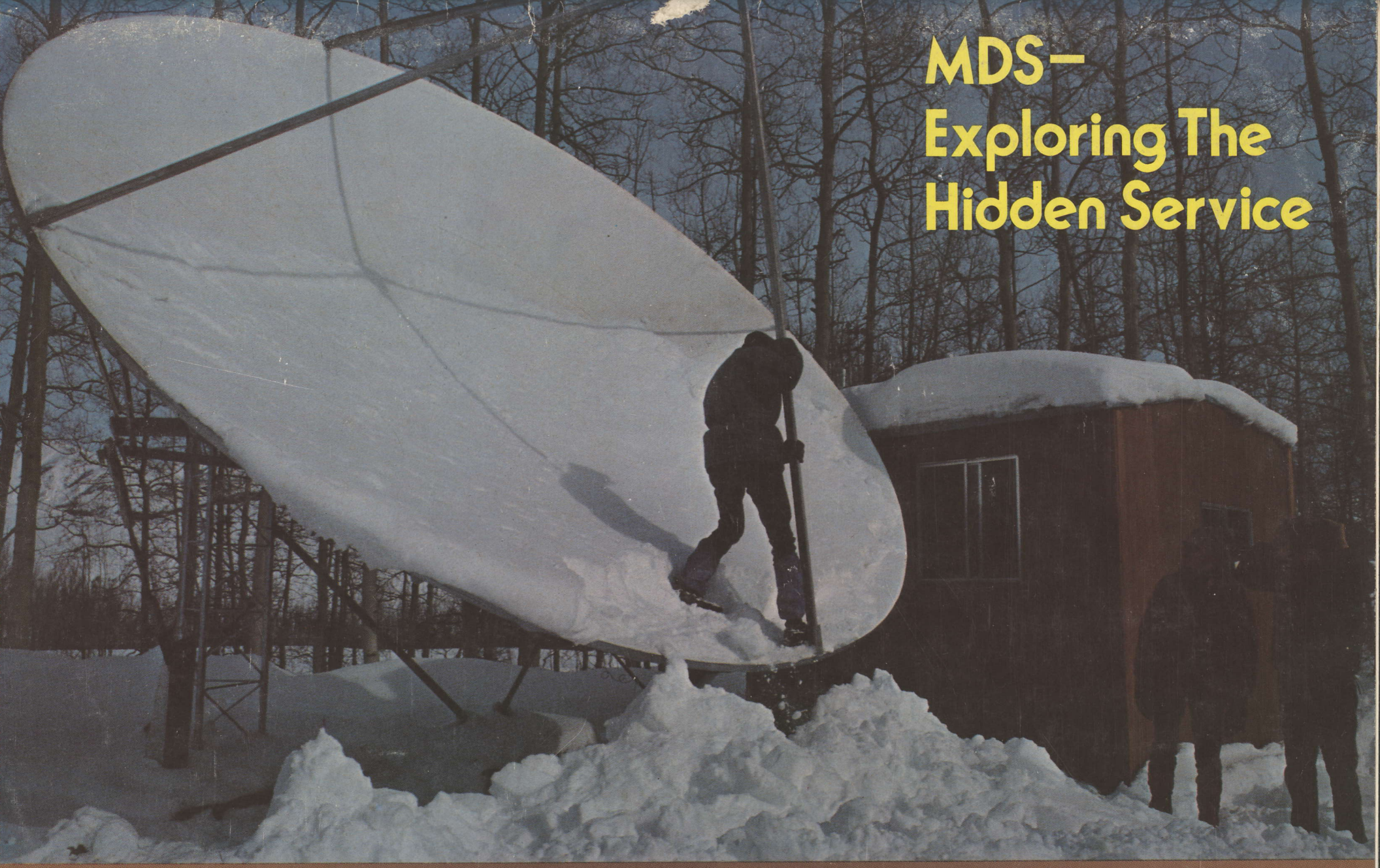


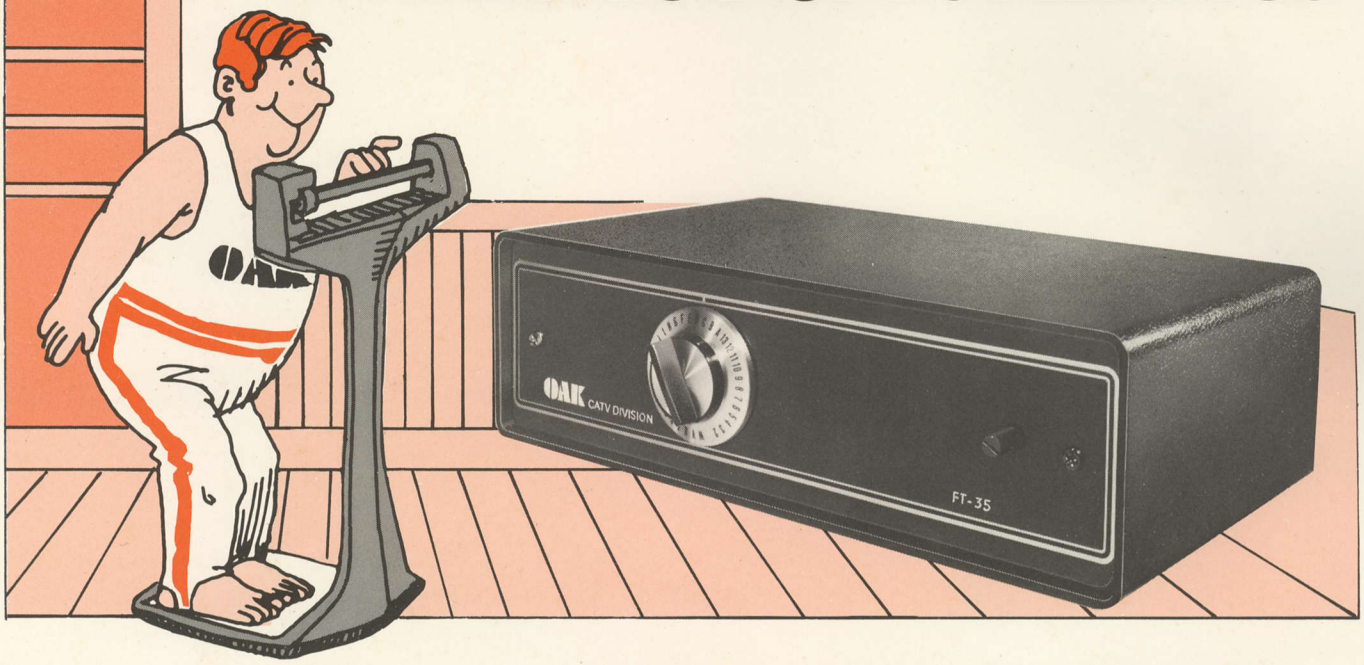
MDS– Exploring The Hidden Service

CATJ

APRIL
1979

OFFICIAL JOURNAL
OF THE
COMMUNITY ANTENNA
TELEVISION ASSOCIATION

New Oak Trimline FT Reduces Overhead ...Builds Performance



Trims hardware costs— not quality

Now you can trim your hardware costs without shaking loose from famous Oak quality and performance. Trimline FT, an economy 35 channel converter, with manual fine tuning, is a new addition to the high-quality Trimline converter series. Very high adjacent channel rejection and low noise figure ensure unmatched reception quality.

35 channel strength

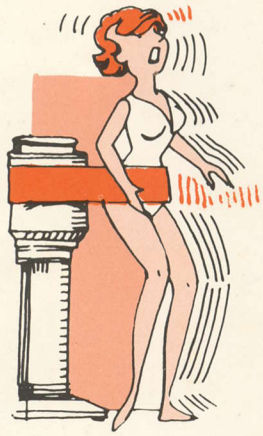
Trimline FT allows for full 35 channel coverage, with accurate tracking for minimum customer fine-tuning. Each channel has its own tuning potentiometer and frequencies are factory set to assure channel selection accuracy. Even if you don't need 35 channel capability, Trimline FT allows room for growth.

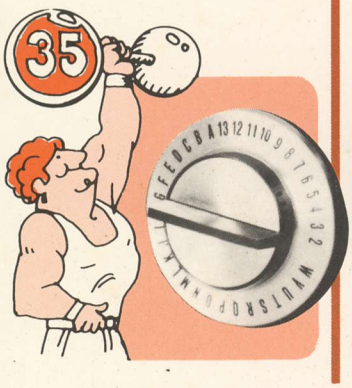
Guaranteed fitness for all

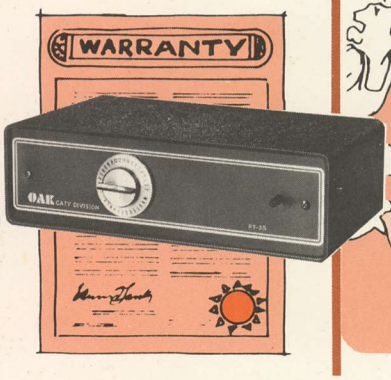
All Oak products are warranted for one full year, no matter how much of a work-out they receive. We support our warranty with rapid repair turn-around. We can back our products better because all Oak products are designed, carefully built and inspected by Oak people in company owned facilities.

You're always a step ahead with Oak

Oak maintains one of the industry's most complete research and development facilities to ensure that our products reflect the best available technological improvements. That's always been our commitment to you and to the industry. The Trimline FT is another example of how Oak sets the pace to keep you a step ahead!







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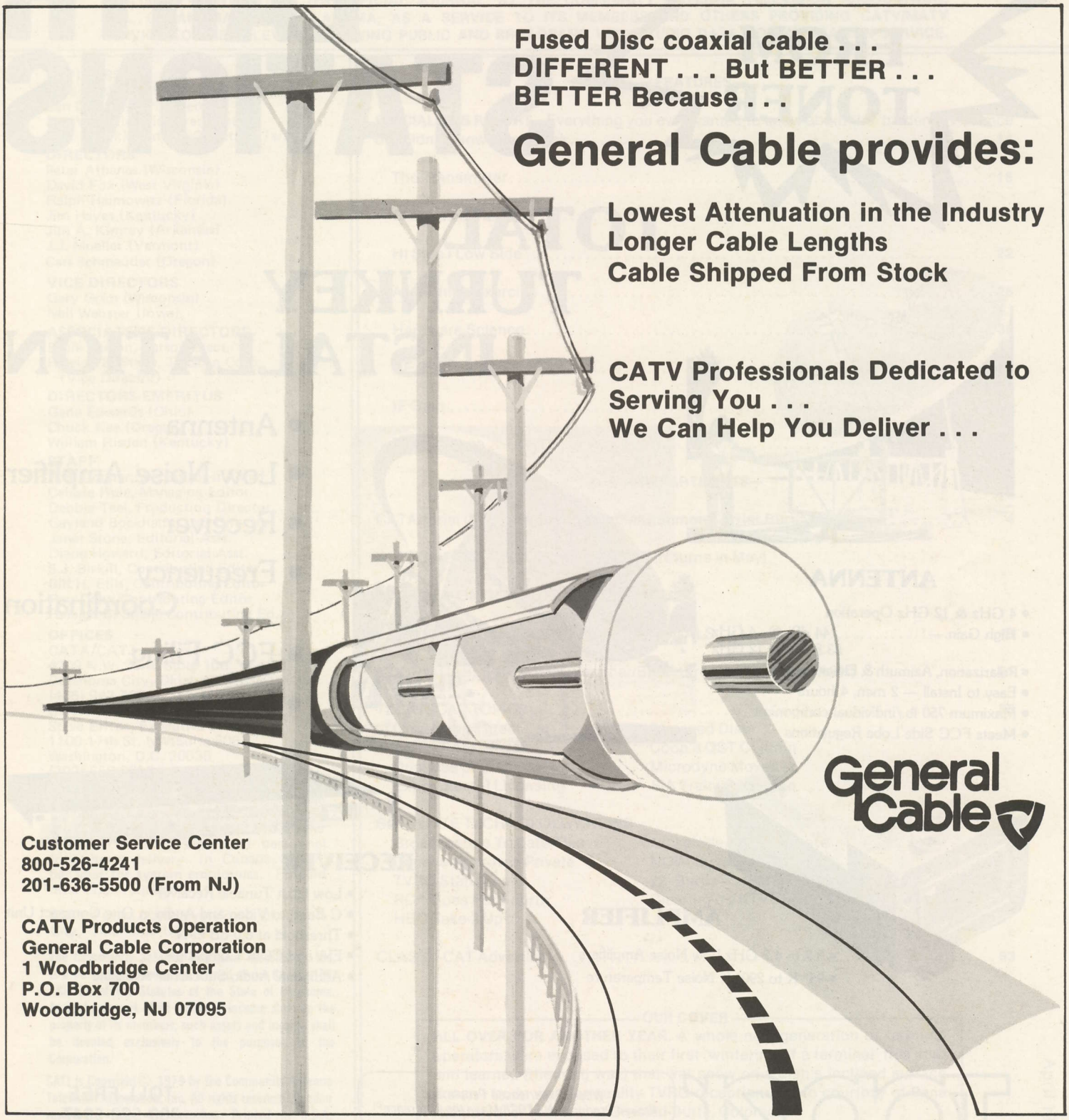

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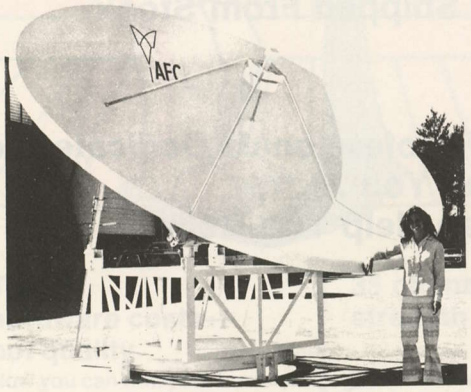

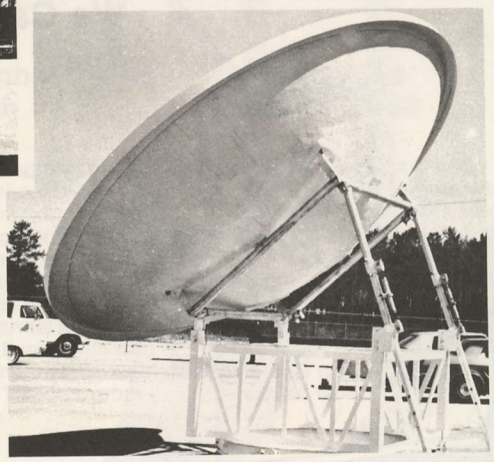

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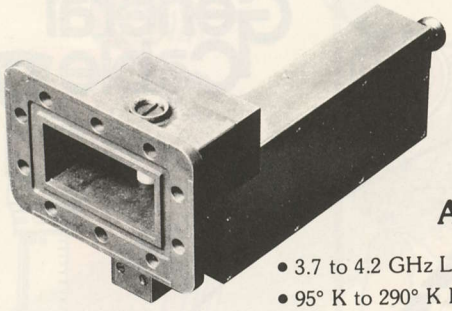

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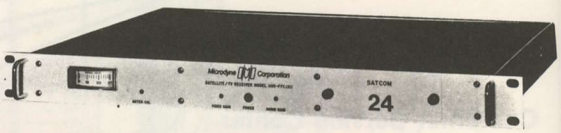

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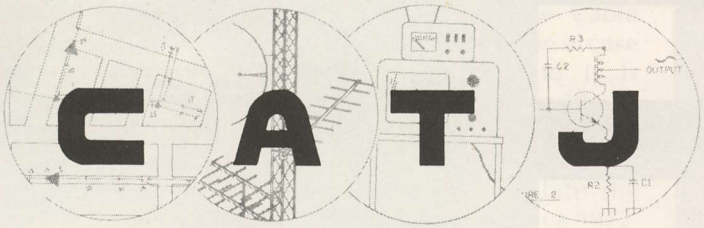

APRIL 1979

Volume 6 Number 4

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The Community Antenna Television Association, Inc. is a nonprofit organization formed under Chapter 19, Title 18 of the Statutes of the State of Oklahoma. As such, no part of its assets or income shall be the property of its members; such assets and income shall be devoted exclusively to the purposes of the Corporation.

—FEATURES—

—DEPARTMENTS—

OUR COVER

ALL OVER FOR ANOTHER YEAR. A whole new generation of terminal operators were exposed to their first 'wintering of a terminal' this year and learned (the hard way) that wet snow on a dish's inclined surface doesn't bode well for quality TVRO reception. Photo courtesy of **Dana Atchley, III** of terminal at Crested Butte, Colorado.

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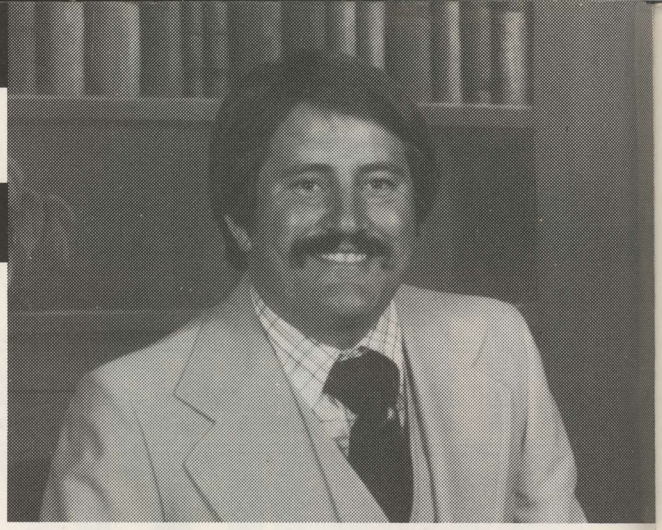
CATA-torial



BEN CAMPBELL, President of CATA, Inc.

THE COMMON-CARRIER CABLE BUREAU?

It wasn't so many years ago that we no longer remember the days when the cable television industry was arguing that the Federal Government should not get involved in cable television matters at all. What possible reason could they have, we argued, to get into our business. Just leave us alone. Of course some of us still take that position, but it didn't have much effect on the Washington-types. They went ahead, through the Federal Communications Commission, to start designing all sorts of rules and regulations regarding our business. They did it at first on an **ad hoc** basis, mainly with folks from the Broadcast Bureau of the FCC, and then finally, after we screamed that we were being regulated by the folks we were competing with, they set up a Cable Television Task Force which became a full-fledged "bureau" in the early '70's.

It turned out that for our own self-interest it was better to have our "own" Bureau than to be regulated as an off-shoot of some other technology. We may not have agreed with what the Cable Bureau folks did, but at least they thought about cable as a separate and distinct entity. At least they knew, or at least some of them did, what a cable television system looked like! To put it on the most basic level, when you called up the Cable Bureau the folks you talked to wouldn't think of calling it a "cable station"! Cable television had its own "home" in the FCC.

There is always a lot of talk about industries "capturing" the agencies that are supposed to regulate them in Washington. The FCC is no exception. Cable, however, was never the industry that "captured" the FCC! The broadcasters were there with their Nets long before we ever got a chance. So things got at least a little better when we got our own Bureau. When issues came up before the Commissioners the Cable Bureau could explain cable's position while the Broadcast Bureau explained the broadcasters position and the Commissioners got at least a little bit of both sides of the story.

There were apparently a lot of stories to tell. From the early days of just a few lawyers and a few secretaries the Cable Bureau grew, by the mid-70's, to a real honest-to-goodness bureaucracy of close to 100 people doing everything from processing all sorts of Certificate of Compliance Applications to checking of franchise problems, setting out technical guidelines, sending out and accumulating data on numerous government forms, going over "special relief" and "waiver" requests, doing "research" on the cable industry, monitoring Equal Employment Opportunities, and the like. Well, the

Transponder Update

The never ending game of musical transponders moves ahead with additional changes either in process or planned for a number of the transponders on RCA SATCOM F1. The moral here continues to be "keep at least one 24 channel tuneable receiver" in every headend just for the liklihood that the channels you are taking off the bird today may not be the channels you need to be taking off tomorrow.

Transponder Service

1	KTVU (via SCS), San Francisco/Oakland; SPN (*)
2	PTL
3	WGN (via United Video), Chicago
4	broken-no service
5	Star Channel
6	WTCG (via SSS), Atlanta; UPI Newstime
7	ESP (**)
8	CBN
9	C-SPAN (daytime), Madison Square Garden (nightime)
10	SHOWTIME (west)
11	Nickelodeon (to 8 PM eastern); Star Channel
12	SHOWTIME (east)
13	broken-no regular service
14	KTBN (Trinity), Los Angeles/Corona
15	RCA data
16	FANFARE
17	RCA data, **video feeds to Alaska**
18	Reuters (digital)
19	RCA data
20	various video services, HBO reserve
21	HTN (***)
22	HBO west; Modern Talking Pictures daytime
23	(HBO's) Take 2
24	HBO (east)

And the explanations. *-SPN (Satellite Programming Network) continues to feed prior to KTVU sign-on (10 AM eastern most days) for approximately 3 hours but will move to transponder 21 around May 1st. **-ESP has a limited schedule of programs up during April (see March CATJ, page 63) but fulltime programming will not begin until September. ***-HTN moved from transponder 1 to 21 on March 1st (KTVU now runs without interruption from sign on to sign off) and SPN will join HTN on this transponder around May 1st.

times have changed and it looks like the Cable Bureau is about to change too, but it may be a case of the cart going before the horse—and it is something that all cable operators should be concerned about.

There is no secret about the fact that the Commission has lost the stomach to regulate the cable business the way it had been doing since 1972. First the franchise rules went, then the CAC requirements were eliminated for under-500 systems, then we got that exemption lifted to 1000. The same thing happened with the nonduplication and the syndicated exclusivity rules. "Leapfrogging" rules were eliminated and a lot of the forms, especially for the small, CATA-represented systems were reduced, streamlined, or eliminated. But the basic signal carriage rules are still there, and the waivers are still needed—so is special relief. The Commission says it is working on those things too—particularly through the so-called "economic inquiry". And when that study is soon done (it should be out before you read this), there will probably be a spate of new rule-makings looking into the questions raised by the inquiry, and specifically whether the Commission should get rid of a lot more of its rules hampering cable.

While all this is going on, of course, there are others who have different ideas. The folks up on Capitol Hill are preparing to "rewrite" or "modify" the basic Communications Act under which we operate. They are talking about letting the telephone monopoly into the business, and they are also suggesting that maybe we should be "structured" more like common carriers, or maybe program suppliers. The National Telecommunications and Information Administration, with our friend Henry Geller at the helm, has also weighed in with a proposal that the FCC go back to his vintage-1968 idea of "retransmission consent" to solve the "copyright problem"—whatever that is.

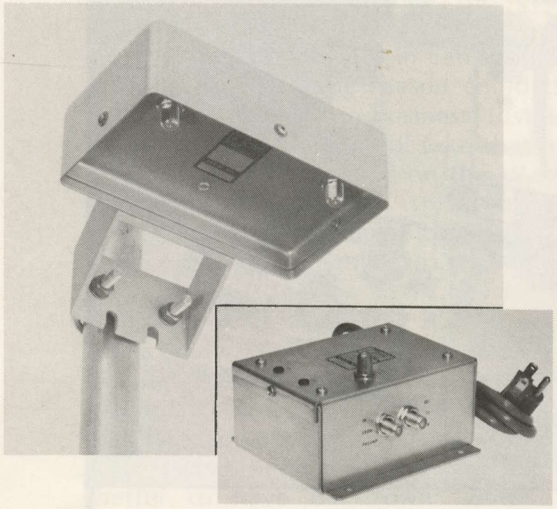
With all this activity going on it is disturbing to learn that there is serious thought being given to **eliminating** the Cable Bureau! Apparently the "powers that be" at the FCC have decided, or at least rumor has it that they have made up their minds to get rid of the Cable Bureau as a separate entity because there isn't much left for the Bureau to do. The strongest reports we get from Washington are that the Bureau is likely to be folded into the Common Carrier Bureau in the relatively near future. This would be the wrong move at the wrong time.

Don't misunderstand—CATA doesn't want any more Government meddling with cable than is necessary, but you don't just lop off the head of one of the players while the game is still going on. We totally support the concept of the Commission, and Congress, and the States getting out of our business. But until that happens it doesn't bode well for cable if the broadcasters and the common carrier folks have their "knowledgable spokesman" in the FCC while cable loses its independent voice. We suggest that the Commission and Congress get their work done first—eliminate the rules on a sensible and expeditious basis, and then the Cable Bureau folks can be reassigned to other tasks—not the other way around.

WE DIDN'T PUT 9 LIGHTNING PROTECTION POINTS INTO OUR SX-0500 PREAMP TO SAVE OURSELVES MONEY . . . WE PUT THEM THERE TO SAVE YOU MONEY.

Of the more than 10,000 Q-BIT Preamps now in service, less than 12 have been returned for credit. They carry a 6 month warranty against anything, including direct hits by lightning. Any damage incurred after that time will be repaired and your unit will be on its way back to you within 24 hours, at a charge of $10 for labor and cost of parts. We don't think you'll find that kind of warranty on any other preamp from any other manufacturer.

SX-0500 CATV ANTENNA PREAMP INCLUDING POWER SOURCE.



$184 complete with mounting hardware.

The gain and low noise figure of Q-bit's SX-0500 VHF Preamplifier has made it the leader in the field, but compare these equally important operational features:

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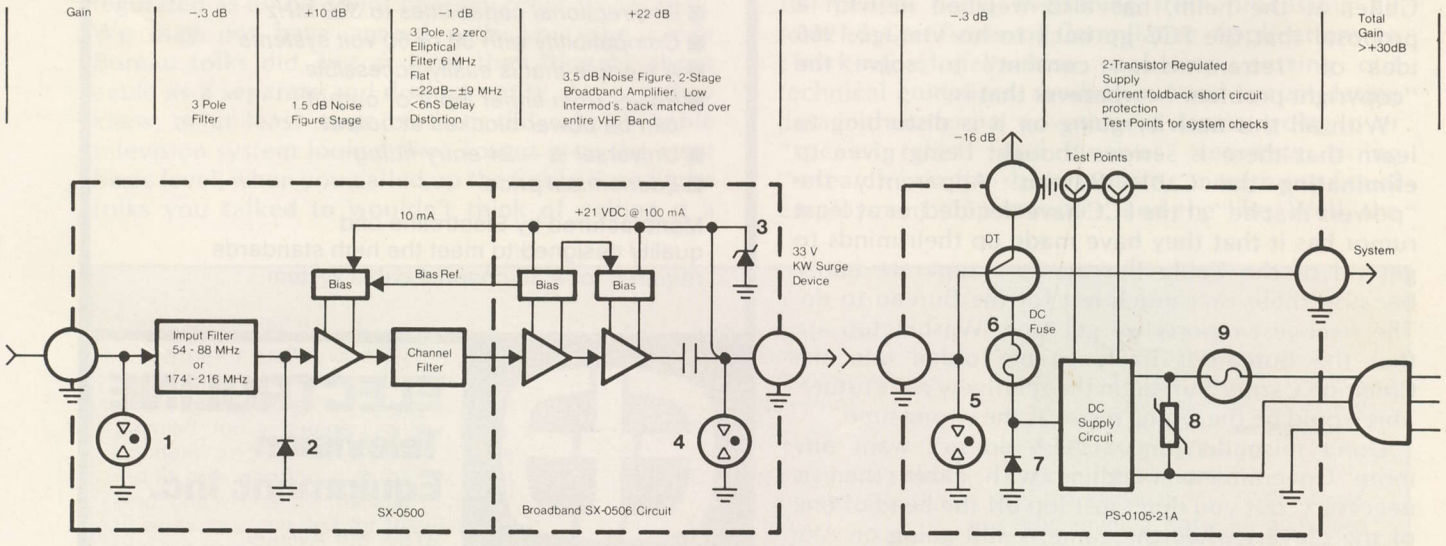

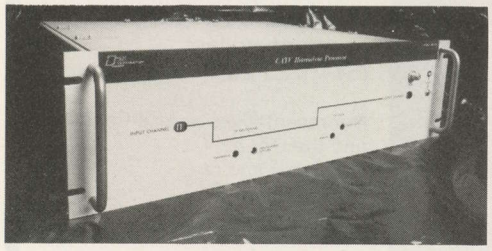

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In addition to 30 dB UHF single and broadband Preamplifiers, Q-bit now offers the most advanced Heterodyne Processor – The QB-650 utilizing the latest solid state technology and components.

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The Microdyne X1 is the best selling satellite TV receiver in the CATV industry. It doesn't simply outsell its closest competitor. It outsells all the competition, combined.

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Reliability — The X1 is a product of Microdyne's 10 years of specialization in the design of high performance receivers for aerospace and satellite systems throughout the world. This depth of experience is reflected in the reliability of the X1 which has an MTBF in excess of 15,000 hours. The X1 provides pictures, not problems.

Availability — Microdyne delivers. To date we have shipped over 1,000 receivers to CATV stations throughout the country. Microdyne receivers are in use in 70% of all active TVRO stations.

Versatility — The 1100-FCC(X1) is EIA/CCIR compatible and will readily interface with an existing TV earth station or a new system scheduled for installation. It's the ideal back-up receiver since changing the channel frequency is as simple as one, two, three: 1) Remove front panel plate, 2) Replace crystal, 3) Adjust one control for maximum reading on front panel meter. Anyone can do this in less than two minutes without any special tools or test equipment.

Low Cost — No receiver is priced more competitively than the X1.

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Get the answers promptly with VITEK's compact Tracer* (TR-1) or Tracer* (TR-2) RF Detection Receivers. Both locate and measure leakage and determine whether radiation exceeds FCC limits. They provide early warning of hairline cracks in expansion loops, loose connectors, leakage from electrical equipment housings, trunks and feeders due to loose covers or corrosion . . . typical leakage problems.

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

Both are rugged, self-contained, powered by rechargeable batteries, offer a crystal controlled local oscillator with front panel frequency trim adjustment and many other features.

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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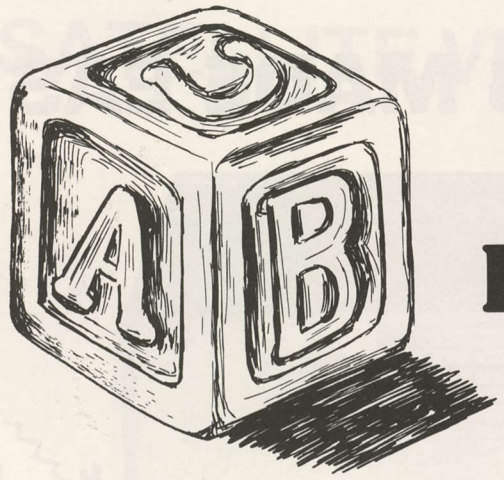


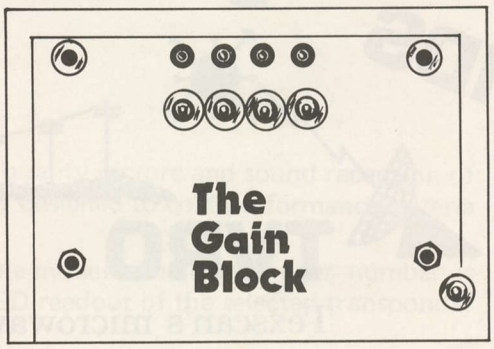
VERY ELEMENTARY

THE GAIN BLOCK

What is more basic than 'gain'? Here is the idea 'shop-mate' for your CATV bench. . .a 117 VAC powered 30 dB "gain block" that produces input to output port hybrid chip gain that covers the range from 30 to 300 MHz (plus!).

The 'Gain Block' was developed in the CATJ Lab as a versatile kit project. No tuned circuits (very high quality Hewlett Packard 30 dB gain gold IC/hybrid on saphire substrate); no tuning, coils or adjustments! Gain extends below 30 MHz (25 dBg at 10 MHz) and up to 450 MHz (still 25 dBg).

All parts are supplied. The housing, regulated power supply (with output jacks to provide a bench-convenient emergency 15 VDC source), the special double-sided etched and drilled circuit board, all controls and components. **PLUS** - a handy manual that illustrates construction plus application of this handy amplifier.



* - **No-tuned-circuits** in the 30 dB "Gain Block" kit. Very high quality Hewlett Packard gold IC/hybrid device on saphire substrate. We guarantee 30 dB gain from 30 to 300 MHz (+ / − 0.5 dB) with no tuning, coils, or capacitors!
* - **Extremely linear** with +50 dBmV output capability at −57 dB cross mod for 12 channel (flat) input!
* - **Circuit board heat dissipation** - at full 30 dB gain rated input voltage of +15 vdc amplifier device runs at 35 degrees C, or less!
* - **High quality** input/output match (typically 20 dB RTL), and 7 dB noise figure at 100 MHz (slightly higher at 300 MHz).

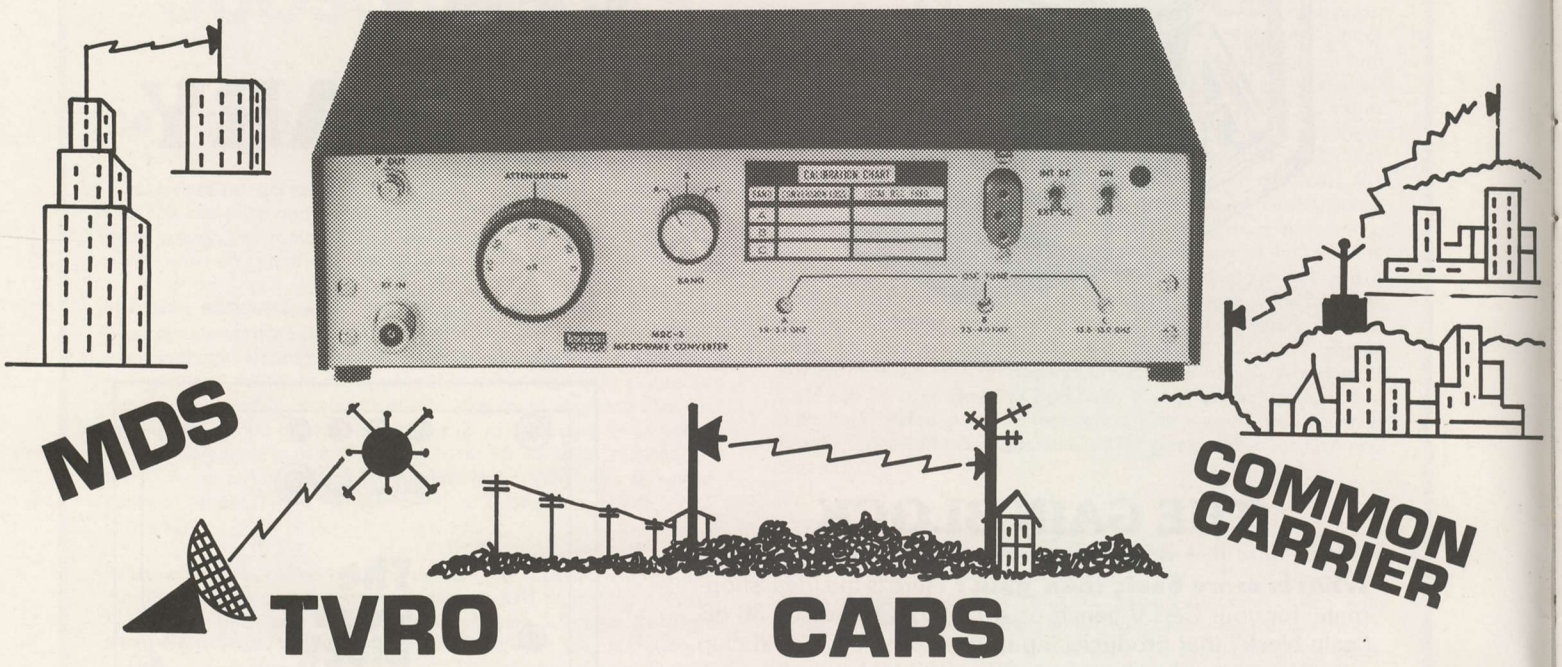
ENGINEERED TO GROW WITH YOU. The 'Gain-Block' is a complete, build, (about two hours time) and turn on bench broadband line-amp with super operating specs; noise figure around 7.0 dB at 100 MHz, excellent input and output match (20 dB RTL typically), and high output capability (+50 dBmV for 12 channels at −57 dBmV).

PLUS - this CATJ Lab Kit has been designed to be versatile. Outboard plug-in modules provide any degree of tilt, external attenuation, high pass and low pass filters, notch filters and bandpass filters you can imagine. . .all done on the unit plug-in clips on front panel so you don't disturb the hybrid chip amp (plug-in module boards will be described monthly starting in May).

THE PRICE is $105 but only as long as our initial supply of "good-buy" HP gold plate hybrid IC's lasts. When the initial stock is gone, the price of the "Gain Block" goes up to $145. So catch us early while this special introductory price is still good!

MICROWAVE

MEASUREMENTS MADE EASY!



Texscan's microwave down converter permits measurement in the MDS (2.1 GHZ) TVRO (3.7 GHZ) and CARS (12.7 GHZ) band with existing VHF test equipment. Spectrum analysis, signal strength and even microwave sweeping are possible with the MDC-3.

Available as an option are three bandpass filters which speed and simplify the measurement process. The filter kit is required for sweep operation. The MDC-3 has a calibrated insertion loss and adjustable local oscillator for each band. Other frequencies are available.

Texscan

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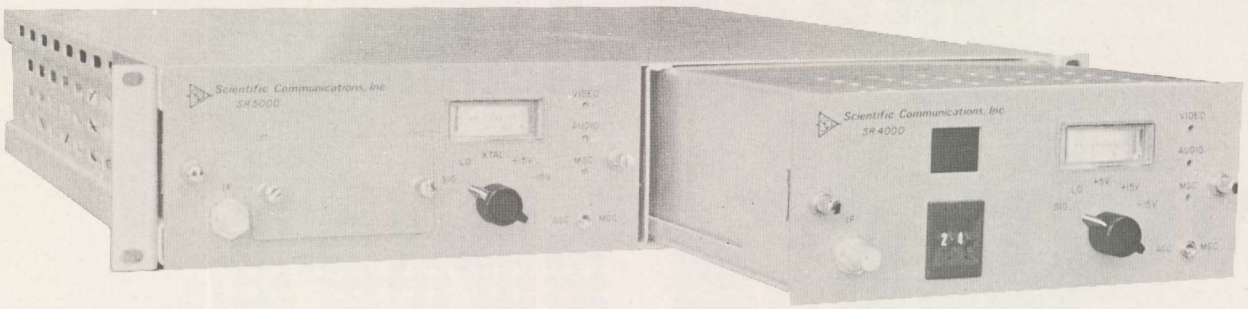

The SR-4000 and SR-5000 Satellite Video Receivers provide quality picture and sound reception of satellite television transmissions. They have been specifically designed to cost/performance criteria for CATV earth stations.

The SR-4000 is a fully agile, synthesized 24 channel selectable model. The transponder number is selected by thumbwheel switches on the front panel with LED readout of the selected transponder number.

The SR-5000 is the fixed channel version with provision for transponder selection by a crystal change and selection of a bianary code on a five position dip switch.

Both units are compact with module interchangeability between unit types except for synthesizer/ L.O. source modules. They each have phase-locked loop demodulators to provide excellent FM threshold performance.

The compact design of these units allows two complete receivers to be mounted in a standard 19 inch rack only 3½ inches high. This feature minimizes the rack space required for multiple receivers when several satellite transponders are to be utilized.

A unique feature of these receivers is the availability of a second subcarrier demodulator. This feature is pre-wired on all units so that the addition of a printed circuit card can provide a second subcarrier for audio, slow scan TV or other software which may be offered by the programming originators.

The SCI receivers were specially engineered to provide simple methods for testing in an operational environment. A meter and selector switch on the front panel permit the monitoring of critical voltages and the IF monitor output is available at the front panel to facilitate C/N testing. An AGC/ MGC switch and a manual gain adjustment are located on the front panel to further facilitate testing. The rear panel contains an auxiliary video output to allow monitoring of video performance without disrupting programming and an extra pair of audio outputs to facilitate audio monitoring.

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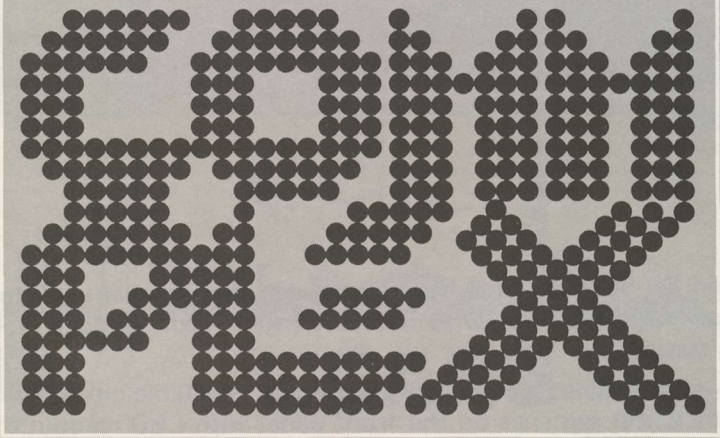

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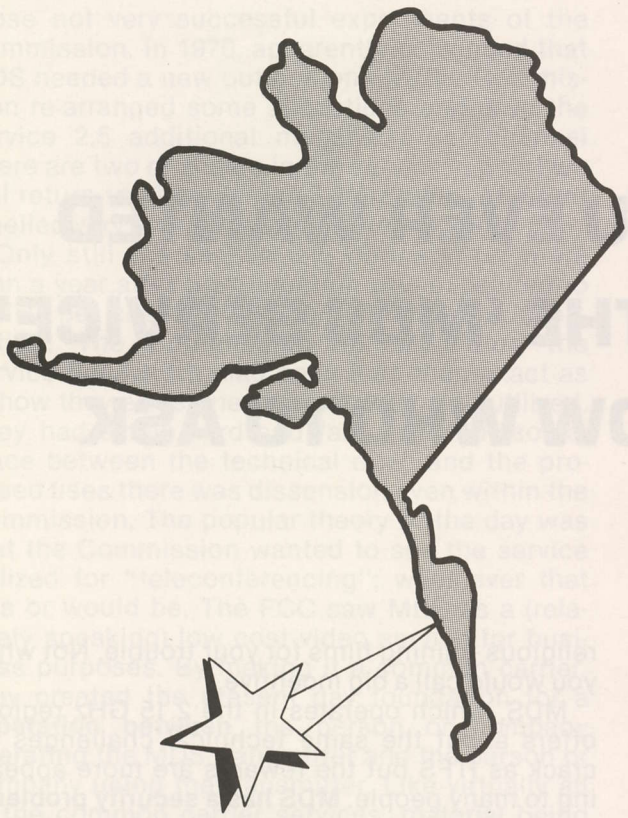

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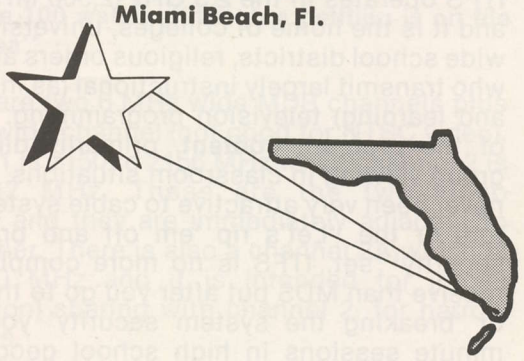


EVERYTHING YOU EVER WANTED TO KNOW ABOUT THE 'MDS SERVICE' BUT DIDN'T KNOW WHO TO ASK

The "Hidden" Service

Years ago the easiest way to disguise a television transmission was to hide it in the UHF band. Not that the transmitters operating there really wanted to be clandestine. . .but when there are no receivers or very few receivers equipped for the particular band you are transmitting on, one has a form of security. In the 'broadcasting service' such security is not desireable nor sought. In other services it is both of the above and more.

MDS. It stands for "**M**ulti-point **D**istribution **S**ervice" and it is the latest plaything of the "let's get rich with television" crowd. MDS is a special type of service carved out of the 2 GHz wasteland. Yes, 2 GHz is normally considered to be microwave and microwave was (until recent years) considered to be a 'safe haven' for point-to-point **private** transmissions.

Microwave receivers have until recent years been complicated. They have also been expensive. Microwave transmission systems, on the other hand, have largely been designed for 'directed beam' service; that is, a very narrow coverage beam focused from the (typically) parabolic transmitting antenna to the (typically) parabolic receiving antenna. Two new FCC services, created at more or less the same time in the early 60's, changed that directed-beam concept. One of those services is **ITFS** (Instructional Television Fixed Sevice) while the second is MDS. ITFS operates in the 2.5 GHz (2,500 MHz) region and it is the home of colleges, universities, city-wide school districts, religious orders and others who transmit largely instructional (as in teaching and learning) television programming. Because of the program **content,** primarily directed at group viewing in classroom situations, ITFS has never been very attractive to cable system operators or the "Let's rip 'em off and break their security" set. ITFS is no more complicated to receive than MDS but after you go to the trouble of 'breaking the system security' you get 50 minute sessions in high school geography or religious training films for your trouble. Not what you would call a big incentive.

MDS, which operates in the 2.15 GHz region, offers about the same technical challenges to crack as ITFS but the rewards are more appealing to many people. **MDS has a security problem,** perhaps a severe security problem because it is acting for the world like a "pay cable service" except it does so without the cable. It replaces the cable with the airwaves and therein is our tale.

A Low Power Broadcasting Station

MDS started off as a 3.5 MHz bandwidth allocation. It is not clear exactly what the FCC had in mind for this new "low cost common carrier" service but real-time television was apparently not on the list of possibles. Television, as we know it, has a tough time fitting into an allocation much narrower than 6 MHz.

MDS didn't go very far with its 3.5 MHz bandwidth. First of all, this was before digital communications came along and try as they might engineers and entrepreneurs were having a difficult time figuring out what to put inside of 3.5 MHz of bandwidth and make money.

MDS was originally conceived as a common carrier service; that is, **a transmitter for hire.** There are parallels throughout the lower frequency spectrum. You go into a local two-way radio shop and you rent or lease a two-way mobile telephone for your car. With the radio goes use of the radio-shop's 'RCC' (radio common carrier) transmitter/repeater. From your mobile telephone you can be patched into the terrestrial telephone service. You are renting the use of both their mobile unit and their land based fixed station (repeater) as well. The FCC apparently envisioned the original MDS allocation in much the same way; a "wide band" system which an entrepreneur could rent out to anyone interested in reaching 'out'. Only nobody came looking for a license and MDS was one of

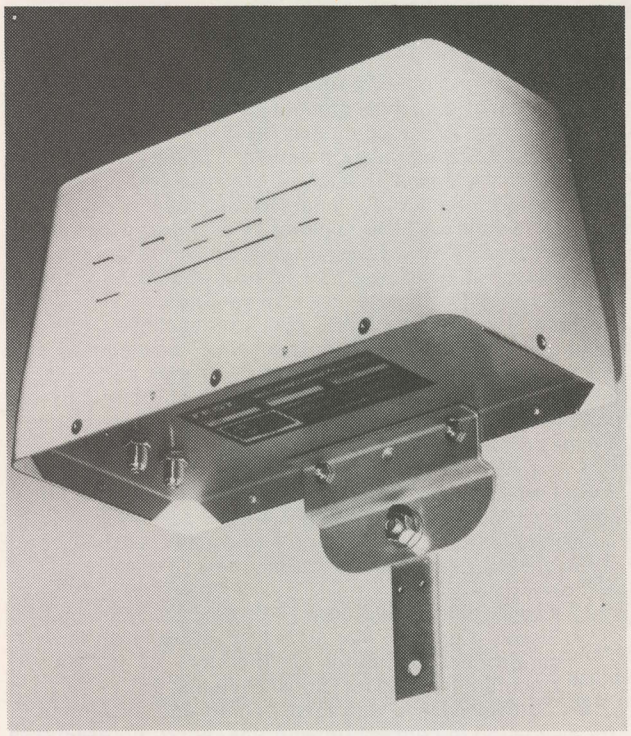
those not very successful experiments of the Commission. In 1970, apparently convinced that MDS needed a new outlook on life, the Commission re-arranged some allocations and gave the service 2.5 additional megahertz per channel (there are two channels in the service; a point we will return to). **Now it was 6 MHz wide.** And that smelled very much like a **television** channel.

Only still the service laid dormant; for more than a year after the allocation was expanded to 6 MHz per channel, nobody submitted an application. The Commission, in expanding the service bandwidth, had been less than exact as to how they envisioned the service being utilized. They had a few hard and fast rules but someplace between the technical rules and the proposed uses there was dissension even within the Commission. The popular theory of the day was that the Commission wanted to see the service utilized for "teleconferencing"; what ever that was or would be. The FCC saw MDS as a (relatively speaking) low cost video service for business purposes. By making it a common carrier, they created the present day foundation for a **separation between** the person or company **operating** the MDS transmitter and the person or company **using** the transmitter. Like virtually all of the common carrier services, material being transmitted must be brought to the transmitter by a "non-related" second party. Unlike the broadcasting industry where the **same** person or company **owns** the transmitter **and** provides the programming, the MDS transmitter must stay a "transmitter for hire" and the person or firm creating the "message" to be transmitted must be a separate entity. On the bottom line, the majority (more than 50%) of the revenues coming to the MDS operator must come from an unrelated party.

What does that mean on the street? That if **you** own and operate the licensed MDS transmitter, **somebody else** must operate the programming business that makes use of the transmitter. As the MDS operator you are entitled to be paid a reasonable fee for the use of your transmitter, but you cannot charge different transmitter-system use rates to different people who are buying the same thing, nor can you refuse use of your transmitter to anyone who wants to rent the transmitter if you have 'time remaining and available' on the transmitter. It's pure common carrier rules, all of the way.

MDS has turned into a pay movie machine. Pay cable without the cable. And, it turns out more and more often these days, without the pay either. And lot's of people are concerned about where it is going. The FCC is one of those parties concerned.

Because MDS was never intended in its original 3.5 MHz wide format to be a pay-movie-machine, many of the early rules adopted are having some difficulty co-existing with the new MDS format. The FCC is looking at some of these problem areas, such as converter selectivity and the like.



Most new transmitters are installed at the 10 watt level. There seems to be some confusion in the field as to whether that ten watts is measured at the output of the transmitter or the end of the feedline (at the antenna). EMCEE says their 10 watt unit will run to 20 watts output **"so the operator can place ten watts to the antenna"** (after 3 dB of feed line loss). Depending upon terrain, antenna height at both ends, transmitting antenna pattern and gain, this usually works out to 10-15 mile coverage with low cost (i.e. 'cost effective') receive converter packages; more with more elaborate receive antennas and electronics. How much hassle is it to get 100 watt authorization? Operators go from 10 (20) watts to 100 watts with an amplifier; an add-on device. Ted Wydell at the FCC's domestic common carrier group says **"The applicant must simply build a case around his need to expand his service area; it is up to the licensee to make his case."** Is there any inherent FCC bias against the 100 watt power level? **"No, none whatsoever".** What about operating with more than 100 watts? **"No MDS licensee has ever been granted permission for more than 100 watts; although a petition is on file in this area".**

There are two 6 MHz wide MDS channels plus a 4 MHz wide channel (not good for NTSC video). Channel 1 is 2150 to 2156 MHz while channel 2 is 2156-2162 MHz. These are the two video channels and they are immediately adjacent to one-another. There is also a channel 2A which is 2156-2160 MHz and it is intended for (cross polarization) sharing with channel 2, for narrow band uses.

COMMERCIAL MDS CONVERTERS

Manufacturers of MDS converter systems have a firm policy **NOT** to sell their product to anyone other than FCC licensed MDS operators, MDS programmers or authorized MDS installation service companies. Those reading this technical report who are encouraged to 'rip off' the MDS service (for whatever reason) are advised that to contact an MDS supplier in hopes of acquiring one (or more) MDS converter units for private use is a total waste of time. And that is as it should be if the shakey integrity of the service is to continue.

The actual number of MDS converter packages in the field is probably surprisingly small. One knowledgeable supplier suggested to CATJ that there may be 20,000 units nationwide; with a high percentage of these in use in the Anchorage, Alaska area in connection with the Visions project there.

There will be many business people reading this report who will feel moved to investigate applying for their own MDS licenses to start a MDS service in their own community. To these readers who may one day have a **legitimate** need for converter units we offer the following.

1) **Magic Lantern Television** (P.O. Box 221/845 Maple Street, Carlisle, Ma. 01741; 617/369-1834) is a nationwide distributor of products of its own manufacture and for Global Systems.

MLT provided CATJ with a pair of units and an antenna for evaluation in connection with this report. An evaluation of the MLT equipment appears separately here.

2) **Tanner Electronic Systems Technology, Inc.** (TEST) at 16130 Stagg Street, Van Nuys, California 91409 (213/989-4535) is well known in the CATV world for their innovative 'scrambler system' (see **CATJ** for May 1976, page 37); they have also been a prime supplier of MDS equipment for many years.

The TEST line of MDS equipment is very complete; at least three separate commercial downconverters plus a battery operated unit for field strength surveys. Plus, an automatic frequency control system, a clever portable television receiver that doubles as a field strength meter of sorts, and a complete line of scrambling and decoding equipment.

To lower still further the basic price of a residential MDS receiving system, TEST recently introduced their model MDSC-MC Mini-Combo downconverter and antenna combination. The antenna is housed inside of the protective covering so the only thing being mounted at the masthead is the 'packaged' downconverter and antenna. TEST says the unit is good "out to 15 miles" and the best part for MDS operators and programmers is the price; in the under $70 range per unit in large quantity (500 and up) buys.

TEST also has a book (appropriately titled **"MDS HANDBOOK"**) which **anyone** interested in MDS should acquire and study very carefully. Written by MDS and CATV knowledgeable-person Ed Stark MDS HANDBOOK takes you through most of the problems associated with MDS system operation; including both transmitting and receiving problems. Price is $7.95 for a single copy or $5.00 each for two or more copies ordered in one shot. Order directly from TEST.

The FCC has no 'allocations table' for MDS but there is a market-approach to making channels 1 and 2 available. When MDS was originally announced nobody could figure out what to do with it, and there was little competition for licenses. This has all changed in recent years and where many of the early licensees got their licenses in 90-120 days the standard practice now is a long, protracted waiting period while competitive applications for the same single channel are sorted through and weighed against one another in competitive hearings.

There is no hard and fast FCC policy concerning granting a second (channel) license in an area with an MDS operation running. **"All we require is that the applicant coming to us have a customer who will buy some of his MDS transmitter time."** When two are actually granted in a single city, what about interference between the two immediately-adjacent -in frequency channels?

"We require that the transmitters be co-located (at the same site) **and of course they utilize opposite polarization to minimize interference"** notes Wydell. Who determines what polarization is initially used by first user on the air in an area?

"If he has no other same-channel MDS operation within 50 miles, he's free to select vertical or horizontal as he chooses. If there is another station say 40 to 50 miles away, there is usually a fight here at the Commission to keep the second applicant from ever **getting on the air. Normally we resolve it by requiring the two to utilize opposite polarizations".** A case in point is the Baltimore and Washington D.C. systems; both on channel 1. **"The second guy in, in a situation like that, is required to insure that he causes no interference to the first guy in".**

Suppose there were two separate MDS transmitters in an area. Could a programmer buy time on both for the evening hours and offer either two different sets of programming, or the same on both as a way of tieing up both channels? Apparently the answer is yes.

The Transmitter Portion

MDS transmitters are relatively low power (for the frequency band) television transmission devices. The FCC allows the transmitters to operate with ten watts visual carrier or 100 watts; although getting permission for 100 watts requires some careful engineering and 'pleading' before the Commission. The transmission format is standard television format; AM video, aural 4.5 MHz removed from the video (and frequency modulated). You can in fact take a VHF television channel CATV grade modulator and 'mix' or heterodyne the output (at say +60 dBmV) up to the 2,150-2,156 MHz output channel and then run the heterodyned signal through an amplifier to develop the desired ten (or 100) watt visual carrier level. The resulting signal is almost exactly like a CATV carriage signal or a broadcast signal; vestigial sideband filtering is required (73.687 of the rules) and the audio has the 'standard' 75 microsecond pre-emphasis circuit. Audio is run 10 dB below visual; a standard 'broadcast' practice which simply means that ten watts of video (peak) matches 1 watt of aural. If you want to know all about the nitty-gritty of the transmitter requirements and the service you'll need **FCC Part 21** (sub-part K) from the Federal Communications Commission.

Practical transmitting antennas are omni-directional (most are) or bi-directional. And special antenna 'patterns' can be created by

phasing antennas together to shape it to fit the population densities as 'seen' from the transmission site. Transmitting antennas are usually situated on an elevated, central point that affords 'line of sight' transmission to the bulk of the intended 'coverage' area. At the ten (or, indeed, 100) watt power level there is insignificant amounts of signal available 'below' line of sight. The 2 GHz signals do have a fair ability to 'penetrate' **structures** within 5-8 miles of the transmitter site however and depending upon the composition of the structure it is possible to achieve noise free reception in close to the transmitter without installing an 'outside' antenna if relatively high quality electronics are employed.

The Basic Receiver

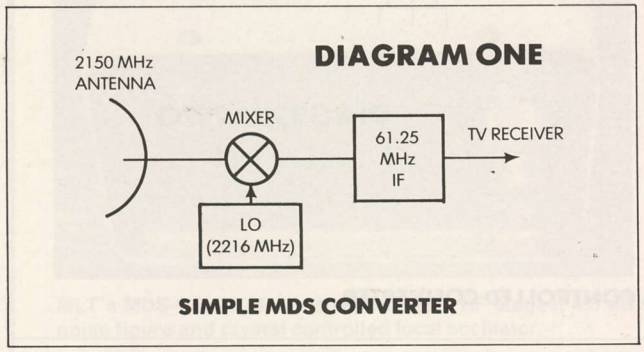
There are three important parameters in the receive site design equation:

1) Antenna gain
2) Receive-converter noise figure
3) Receive-converter conversion 'gain'.

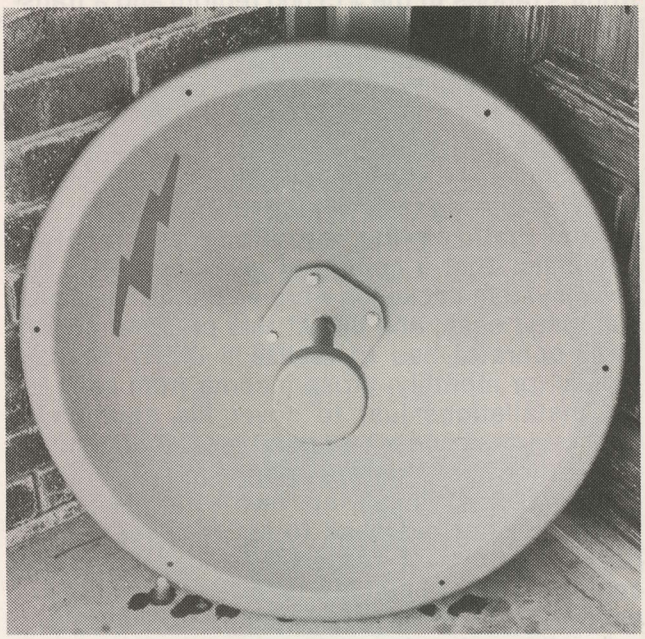
The simplest **commercial** form of MDS converter is shown in **diagram one.** A 2.15 GHz antenna captures some amount of RF from the air and delivers the RF to a mixer. The mixer marries the input RF signal to a locally generated oscillator (LO) and from that marriage comes a sum (RF + LO) and a difference (RF − LO) set of signals. If the input frequency is 2,154.75 MHz (video carrier frequency) and the LO is operating on 2216.0 MHz, the **sum** of the two is 4,370.75 MHz while the difference is 61.25 MHz. In this case 61.25 MHz is the one we want; it matches the VHF channelization of television channel 3.

The 61.25 MHz output from the mixer then travels through an IF (intermediate frequency) amplifier tuned to 61.25 MHz and the output of this stage is carried via standard coaxial cable to the waiting television receiver.

In this type of 'installation' the antenna gain is flexible with the installer; however the **receiver-converter noise figure** is set by the conversion efficiency of the mixer stage and the receive-conversion 'gain' is established by the gain of the IF amplifier. One way to look at mixer noise figure is to simply call it a 'negative dB' number since **mixer noise figure** is largely **a loss of signal** in the frequency conversion process. Two types of mixers are commonly employed in this service; the simple **diode mixer** exhibits 7 to 8 dB



SIMPLE MDS CONVERTER



TWO FOOT MDS ANTENNA (Andrew) **is one of several available to market. Parabolic antennas are typically not utilized except where there is multi-path problems or when receiver terminal is located at outer fringes of coverage area.**

of conversion 'loss' while the slightly more sophisticated double-balanced mixer typically has 6 to 7 dB conversion loss. In the practical world if a mixer has 8 dB of conversion loss and the IF amplifier has (typically) 12 dB of (IF) gain we end up with a **net conversion gain** of 4 dB (−8 + 12). If the coaxial downline from the converter to the receiver has an additional 2 dB of loss, the total 'gain' of the receive system becomes 2 dB (4 − 2). On the bottom line this says your (example) 61.25 MHz IF signal of the MDS carrier will be 2 dB stronger than the 2,154.75 MHz converter input signal. If we relate all of this to our 0 dBmV (1,000 microvolt) standard TV receiver input signal that prevails in the cable television world, this says that the 2,154.75 MHz **signal to the mixer input** must be no weaker than −2 dBmV (800 microvolts across 75 ohms) with this simplistic package if we are to realize 0 dBmV to the television receiver. In the real world a 15 dB gain MDS antenna will produce this level of 2,154.75 MHz signal within five miles or less of the transmitter under line of sight conditions. All of which suggests that if you are going to carry the MDS signal very far, or if you have a requirement for a higher IF output than 0 dBmV you will need to increase the efficiency of the receive system.

The MDS world is like any other business world; cost-sensitive. Because the MDS system must ultimately realize a profit from its operation every part of the cost side of the ledger must be closely scrutinized. Let's look at a typical business situation. The MDS program supplier wants his programming to be available to the widest possible market. To do this the MDS station operator selects a transmitting package (typical 10 watt transmitter/antenna/associated elec-

tronics ranges in the $15,000 region) and a transmitting site which affords him line of sight coverage to the intended market. All of this is a one-time and hopefully non-recurring cost.

But the transmission system isn't worth very much unless there is somebody out there to receive the signals. Which brings us to the crucial half of the equation; **the receive-terminals.** Just a couple of years ago MDS receive system packages were selling in the $400/500 range each; **and up.** At this price range the MDS operator had to realize a pretty healthy annual (or monthly) gross income from **each** of his installations just to cover his equipment costs. In fact when he added his programming acquisition fees, his operating overhead (rental of the MDS 'air-time'), his own office and field technical staff overhead to his receiver-system package costs it turned out that **he really couldn't afford to install a receive system** unless each receive system served **multiple** subscribers. Apartment houses, condominiums and even smaller cable systems became his primary customers because **one** receive installation could serve several dozen or **several hundred** 'sub' customers.

Then two things happened to re-balance the equation. Technology came to MDS receiving systems, and, a limited amount of higher volume production followed. Today a complete MDS receiving system, consisting of a suitable antenna, the down converter and the power supply for the converter sells as a package in the $70 range. And this has changed the direction and complexion of the market. **Individual homes,** not previously economic to serve, are now becoming a big factor in the MDS business.

Of course the revolution in equipment costs has not changed the basic laws of physics which govern MDS transmission range and receive-system engineering parameters. If our simple commercial systems does not provide adequate system gain, a more elaborate approach to the receive terminal is required.

Which brings us back to the basics of the receive system. To achieve the desired 0 dBmV input to the television receiver and maintain a high quality signal to noise ratio (1,000 microvolts of 'signal' wouldn't be of much use if 800 of those microvolts were 'noise'!) requires something more than the elementary 'crystal set' engineering found in diagram one.

To improve the end-result signal several things must be done to the receive system. The most obvious thing to do is to increase the gain of the MDS receiving antenna. However it turns out that antenna gain becomes expensive beyond a certain point; and that point is between 15 and 17 dB (of gain). Using a helical antenna, or a small corner reflector or even a small horn antenna is a practical way to get up to or just over 15 dB of gain at 2.15 GHz. Beyond that gain level you are into more exotic antennas; parabolic reflectors, phased arrays of smaller antennas and like that. Helical antennas have manufacturer's 'loaded-costs' in the under $8 region while small horns and corner reflectors may run a tad less. A (relatively speaking) 'small' two foot parabolic, on the other hand, gets up there close to the $50-80 region very quickly at the manufacturing level. So there is only so much you can do with the antenna and stay cost effective with the package. The difference in gain between the two foot parabolic and the less expensive antennas is in the 3-5 dB range (two foot is typically around 20 dB of gain).

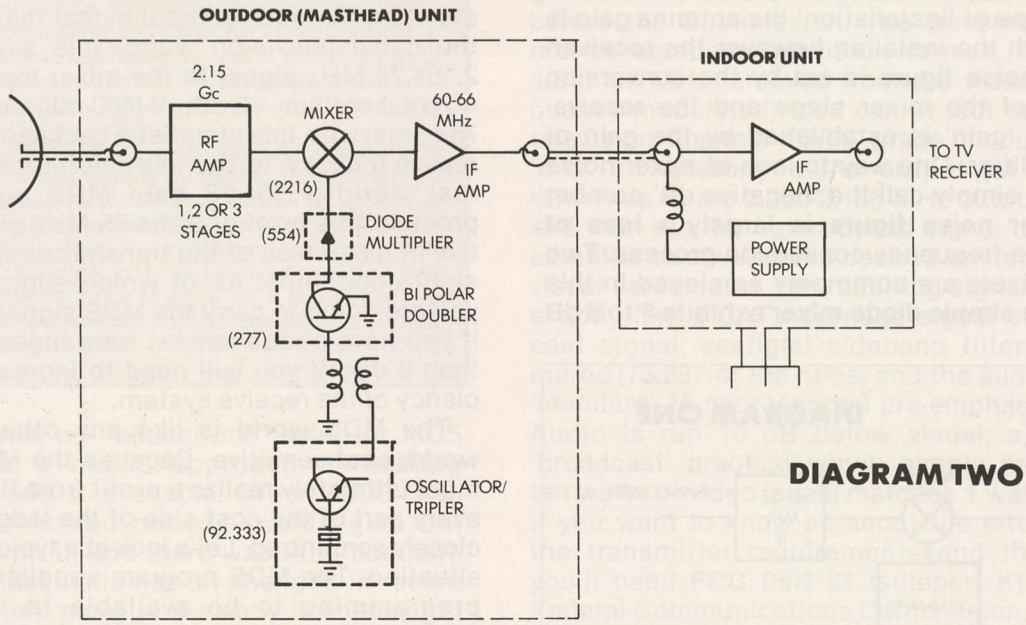


DIAGRAM TWO

TYPICAL COMMERCIAL CRYSTAL CONTROLLED CONVERTER

MAGIC LANTERN TELEVISION

One of the major suppliers in this field is **Magic Lantern Television** (Box 221, 845 Maple Street, Carlisle, Ma. 01741; 617/369-1834). Magic Lantern provides products of its own manufacture and products manufactured by Global.

MLT provided the CATJ Lab with a pair of units plus a (MDS-17TH) 'tuned horn' antenna which we ran through the paces at a number of off-air sites for about two months time.

Model **MDS-1**-(IF channel) with the MDS-PS (power supply) is the top of the line unit. The primary market for this unit is CATV systems and large MATV systems where high frequency stability and signal to noise ratio is important. Gain of the package is 30 dB (verified by the Lab) and the rated noise figure is 4.5 dB (not verified by the Lab) with three RF stages. Any output channel is available including mid and super band channels. This is a crystal controlled unit with an output stability of .005% over a temperature range of −40 to +60 degrees C (not vertified in the Lab).

We were impressed by the unit and found it would operate over a wide range of input power supply voltages below the specified −21 VDC.

A second unit (not tested by the CATJ Lab) is their **MDSA-1**-(IF) designed for smaller apartment complexes. This unit has a pair of RF stages, typical gain of 23 dB and a noise figure of 5.5 dB. Same power supply as the MDS-1 and any output channel available (crystal controlled oscillator).

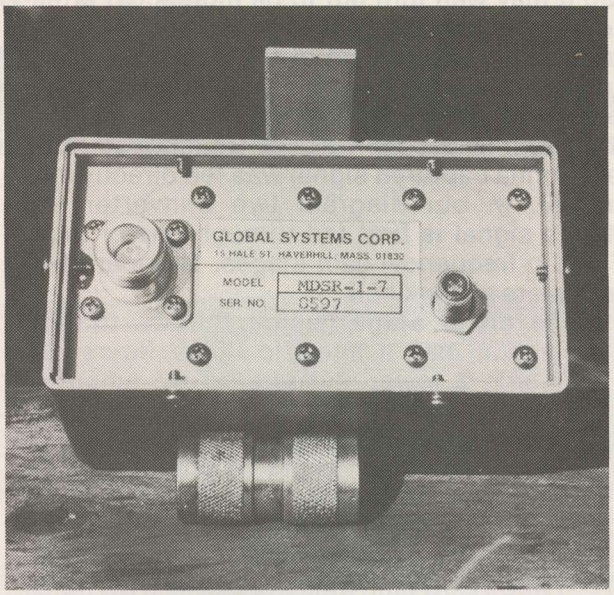
The third unit in the line is their low-end **MDSR-1**-(IF); intended for private residence use. This unit also has a pair of RF amplifier stages, a temperature compensated local oscillator with 17 dB of gain and a typical noise figure of 6.5 dB. MLT/Global uses a technique widely utilized by the non-crystal controlled design engineers; to track the possibly 'moving IF' there is a pot or control on the set-top half of the package. Adjusting this control allows the user to vary the oscillator tuning voltage to the LO in the converter, thereby fine tuning the IF output to match it to the TV receiver channel.

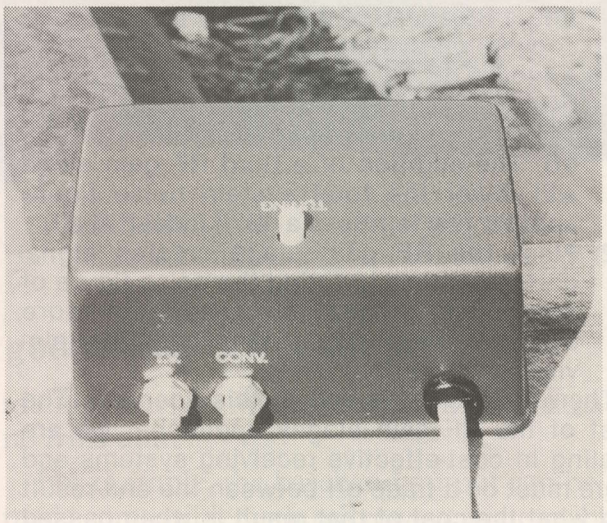
List prices for the MLT gear varies from $322 (MDS-1) to $110 (MDSR-1).

MLT offers a fair variety of antennas. MDS-24P is a grid antenna 48 inches in diameter manufactured by TACO. The grid reflector is constructed from 1/8th inch steel rods spaced at 1 inch welded to a 1/4 inch diameter outer steel ring. Weight is 28 pounds and price is $200. Gain is 24 dB. A smaller version, a two foot parabolic solid antenna, the MDS-20P has 20.5 dB of gain with a dipole feed and a protective radome. Price is $135.

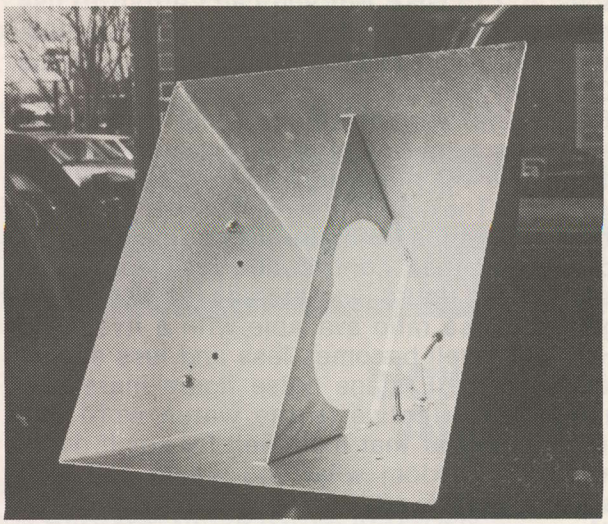
For most areas a 17 dB gain 'Tuned Horn' system will function well at a cost effective price ($32). MLT provided the Lab with this antenna and we found that it does indeed have 17 dB of gain when compared against a reference antenna of known gain.

MLT's MDS-1 solid state converter has 3 RF stages, 4.5 dB noise figure and crystal controlled local oscillator.





MLT's MDSR-1 temperature compensated converter has 17 dB of gain, two RF stages, and a noise figure of 6.5 dB. Model MDSR-PS set top power supply unit has 'tuning control'.



MLT's MDS-17TH 'Tuned Horn' antenna can be utilized for either polarization, has 17 dB of gain.

So it may well turn out to be more 'cost effective' to tackle the package sensitivity and conversion-gain problem at the converter itself. In **diagram two** we have a representative block-diagram of a 'high quality' MDS converter package. In our simple-converter (diagram one) the antenna captured signal was fed directly into a mixer. In our diagram two converter the antenna signal is first fed through one or more RF (radio frequency) gain stages. There are two parameters at work here:

1) **The mixer stage** (which follows the RF stage(s)) has a specific noise figure. By placing a lower-noise-figure RF amplifier stage **ahead of** the mixer stage we can **reduce** the total converter noise figure to something closer to the RF amplifier noise figure than to the mixer noise (conversion loss) figure. With a 6-7 dB mixer conversion loss (i.e. noise figure) the addition of a single 12 dB gain stage of (say) 2.5 dB noise figure RF ahead of the mixer will reduce the conversion system noise to approximately 4.5 to 5.0 dB. By adding yet another (second) RF gain stage we can lower the total converter noise figure down to around 3.0 to 3.5 dB. The addition of a third RF gain stage will lower the total system noise figure another few tenths of a dB; if indeed at all.
2) **Plus**—the RF gain stage creates signal gain as well as lowering the noise figure of the converter and this results in more dBmV at the IF output that feeds the television receiver.

There is one bug-a-boo in this scenario. The cost of the RF gain stages; remember we are dealing in cost-effective receiving systems and there must be a trade off between the end result and what the cost of that result is when passed on to the equipment user. There are any number of 'exotic' RF small-signal transistors out there which sell in the $15 to $20 range each and which make dandy 2.0 dB (and lower) noise figure RF stages at 2.15 GHz. But you can't afford to use very many of these (if indeed any) in a commercial package that sells to the MDS operator in the $100 range.

Below the 'exotic' small signal transistors available is a myriad of $2-$5 devices that can produce 3-5 dB noise figure RF stages at the frequency. They still provide the voltage gain (which affects the dBmV levels sent on to the TV receiver) but their contribution to lowering the system noise figure (and thereby increasing **the signal to noise ratio** available with a fixed 2.15 GHz input level) becomes less and less significant as their RF stage noise figure increases. Again, cost effective is the watch word and commercial gear that must sell for small dollar amounts is seldom what you would call 'ultimate' state-of-the-art.

If you are going to go to the trouble of building in one or more RF gain stages, as we have done in diagram two, you might as well also look at another 'problem area' in the MDS converter basic design; **frequency stability.** The integrity or frequency stability of the IF output signal depends upon two factors:

1) The stability of the MDS transmitter's operating frequency, and,
2) The stability of the local oscillator (LO) that meets the MDS signal in the mixer stage to create the frequency conversion to IF.

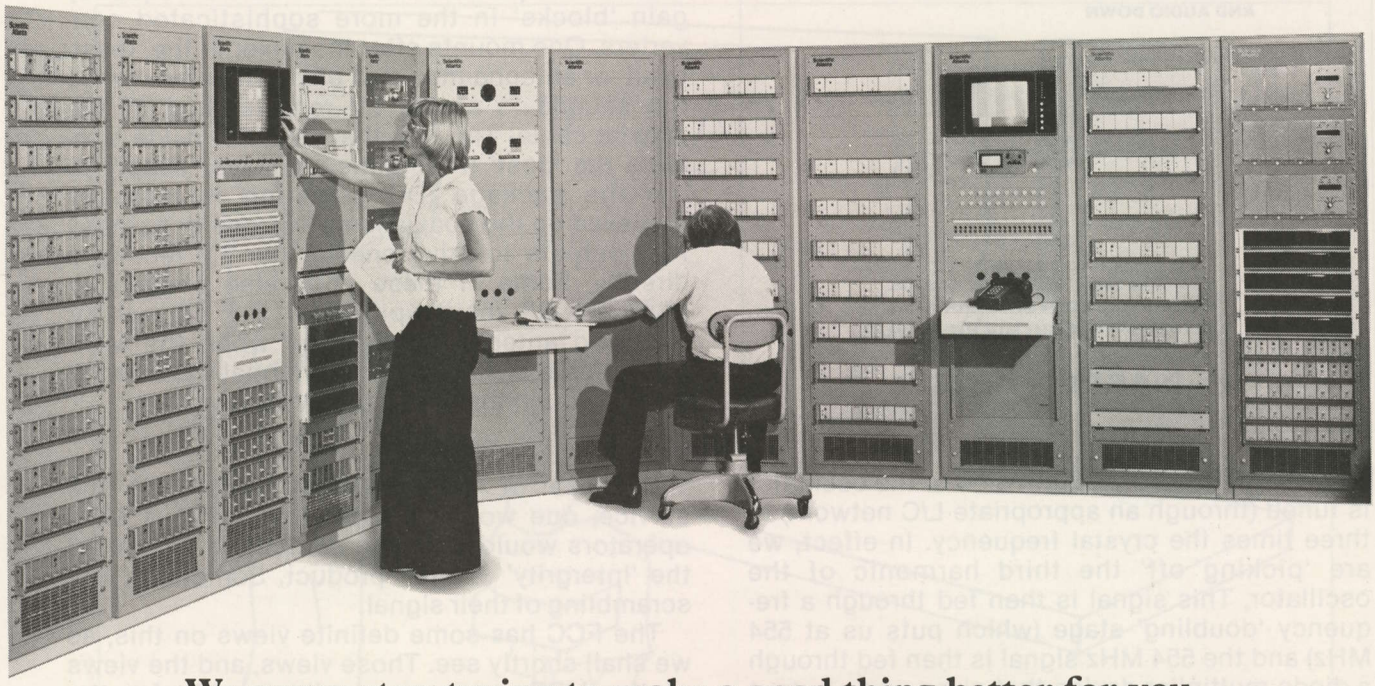
There is not much **you** can do with the MDS transmitter to make it go wandering around; the FCC has seen to that. This leaves us with doing what we can to 'stabilize' the LO injection signal. Almost anything you can do will cost money and so we are back to the cost-effective area very quickly.

The most cost-effective LO is one that 'runs freely'; that is, it consists of a transistor oscillator that operates at the proper LO frequency with the actual frequency determined by an L/C (inductance and capacitance) circuit. If your oscillator was operating at say 1.000 MHz and it was in a reasonably stable environment you could expect the oscillator to stay within a few cycles of 1.000 MHz and not worry too much about it. **However** when the oscillator operates at **2,166 MHz** and it is housed inside of a metal container that sits in the hot daytime sun and the cold nighttime snow you can reasonably expect the oscillator to drift or change frequency on you.

One solution to this problem is to not allow the oscillator to be free-running at all. Rather than depending upon an L/C circuit, you derive your frequency source from a (quartz) crystal incorporated into an oscillator. This guarantees stability several tens of times better than a free running oscillator but it also requires a bunch of additional circuitry. In diagram two we have a most common approach to the problem; a 100 MHz 'range' crystal is selected so that some multiple of the crystal fundamental frequency will multiply upwards to the desired LO frequency. The actual LO frequency is chosen by working backwards from the MDS input frequency (typically 2,154.75 MHz for the video carrier) to the system-desired IF channel. Simply take the MDS frequency and **add** to it the frequency of the VHF TV channel (visual carrier) you wish to convert to. That gives you your LO signal frequency. Then divide that down (first by 4, then by two, then by three) to arrive at the crystal oscillator frequency.

Working it the other way, the oscillator in the 100 MHz region must end up in the 2.2 GHz region. It needs to get to the mixer with adequate 'power' to make the mixer work efficiently and without a bunch of beats, harmonics and subharmonics of its own since the presence of other oscillator frequencies in the LO range will both 'garbage' the IF output signal and also create additional undesired IF outputs where they are not wanted or needed. In our sample converter in diagram two the 92.333 MHz crystal is placed in

Finally, the headend satellite receiver.



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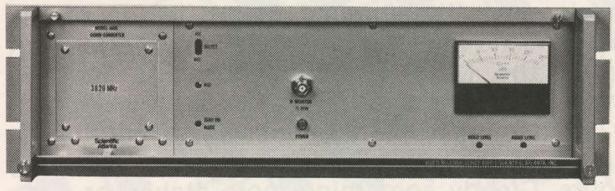

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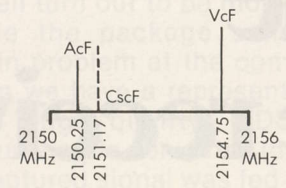
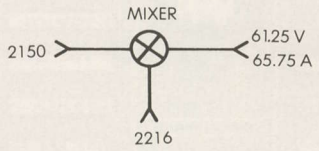


MDS VIDEO AND AUDIO ARE INVERTED FROM NORMAL RELATIONSHIPS WITH VIDEO "UP" AND AUDIO DOWN



BY EMPLOYING "HIGH SIDE" LOCAL OSCILLATOR, CONVERTER OUTPUT IS RESTORED TO "RIGHT SIDE UP" FORMAT

DIAGRAM THREE

an oscillator and the output side of the oscillator is tuned (through an appropriate L/C network) to three times the crystal frequency. In effect, we are 'picking off' the third harmonic of the oscillator. This signal is then fed through a frequency 'doubling' stage (which puts us at 554 MHz) and the 554 MHz signal is then fed through a diode multiplier device that gives us an output at 4 times the 554 MHz input signal; or 2,216 MHz.

If the oscillator is well designed and well built the IF output frequency will be in the 0.005% frequency tolerance range and it will stay there under normal temperature extremes.

There are other ways to accomplish the same goal. For example, the voltage which operates a free-running (L/C) oscillator could be remotely tuned at the TV receiver and by **changing the voltage** to the oscillator slightly the oscillator will shift frequency and be tuned **back to** the proper frequency to bring the IF out where it should be. This is the way the present generation of **non**-crystal controlled converters function; leaving the 'fine tuning' in the hands of the viewer. This works fine for individual viewers but when the MDS receive system is feeding multiple receivers (as in apartment houses, etc.) it is too much to ask that one viewer monitor the tuning of the control during all normal viewing hours. Clearly something more stable, or automatic is required.

Another approach is to monitor the actual IF output signal for its frequency. By 'counting' the IF output frequency electronically, and comparing the actual output frequency to the required output frequency a form of 'AFC' or automatic frequency control can be built into the system. With this approach rather than requiring that a human being tune the fine tuning control to bring the picture back when the free-running oscillator drifts, an electronic circuit does the sensing and the tuning of the oscillator tuning voltage.

On the bottom line, all of this costs more money than simply allowing the oscillator to 'run free' and asking the customer to fine-tune his own picture.

Finally in diagram two we see that there are often two separate IF or intermediate frequency gain 'blocks' in the more sophisticated converters. One mounts after the mixer in the 'masthead' or antenna-mounted electronics box while the second is at the TV receiver end of the coaxial cable. The box that mounts inside contains the 'post' IF amplifier, a power supply to run the package (DC powering is typically duplexed up the coaxial line) and one or perhaps four outputs to drive one to four TV receivers directly. Some of these units also contain an alternate RF input spigot for the normal TV receiving antenna system and when the MDS converter is switched off the normal TV antenna feeds through the box to the TV receiver.

High Side / Low Side

Because of the 'premium' nature of the service, one would suspect that nervous MDS operators would be doing something to protect the 'intergrity' of their product. Something like scrambling of their signal.

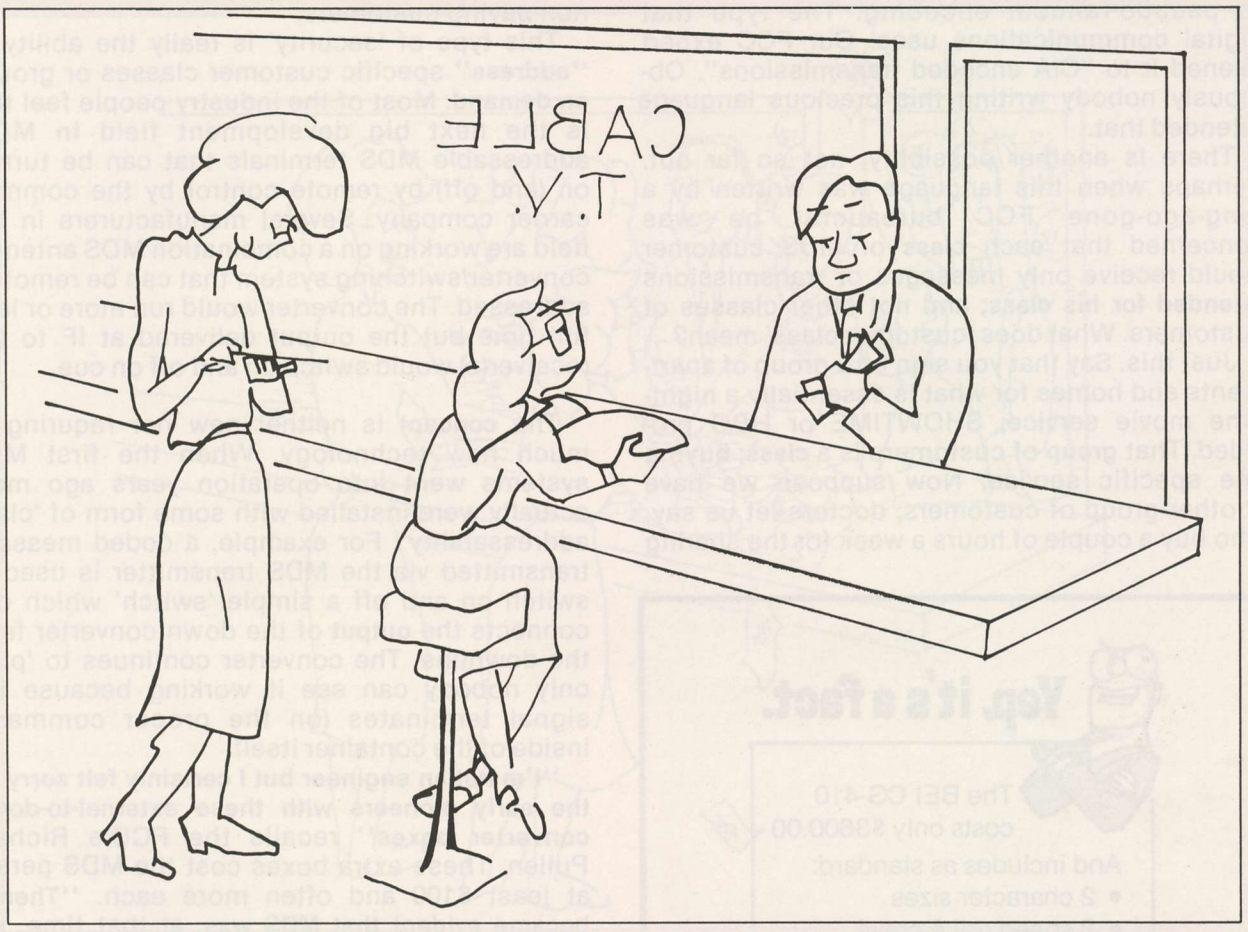
The FCC has some definite views on this, as we shall shortly see. Those views, and the views of the MDS program suppliers aside for the moment, there is built into the MDS system one form of 'soft' security that stops virtually nobody that has a head on their shoulders.

The MDS 6 MHz bandwidth is formated **almost exactly like** the regular NTSC broadcast signals. The video is AM, the audio is FM and there is a nominal 4.500 MHz offset between the two. Color rides along at 3.58 (etc) MHz removed from the video. However, as **diagram three** shows, the video and audio **are inverted** from the normal relationship; the video carrier appears at the high end of the passband while the audio carrier appears at the low end. This is the result of the method utilized in 'mixing' a low (VHF channel) TV modulated carrier up to the MDS band. In the mixing process, the carriers become inverted with respect to where they started out.

This is why the MDS converter LO's are found on the **high side** (i.e. above the MDS operating frequency) and this is just the opposite of what most CATV people are accustomed to with V to V or U to V conversion schemes. What happens if your LO is on the 'low' (wrong) side? You can still tune in the picture, and the sound; but not together since the TV receiver's IF is set up to pick off the audio 4.5 MHz below the visual carrier and with a low side LO it ends up 4.5 MHz above (TV receiver IF is 41.25 MHz audio and 45.75 MHz video carrier frequencies).

That much 'security' aside just where is the security question with MDS these days?

"Before"



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The industry is in a quandry. The FCC rules provide that the (common) carrier will normally "provide complete security of transmission". The problem is that no-one, not even the FCC, knows what that phrase means.

. . .(the) carrier will provide complete security of transmission''.

A source **within** the Commission has several interpretations. For example, one suggestion is that complete security requires something akin to pseudo-random encoding. The type that digital communications uses. Our FCC expert likened it to "CIA encoded transmissions". Obviously nobody writing this precious language intended that.

There is another possiblity; not so far out. Perhaps when this language was written by a long-ago-gone FCC bureaucrat he was concerned that each **class** of MDS customer would receive only messages or transmissions **intended for his class;** and not other classes of customers. What does 'customer class' mean?

Just this. Say that you sign up a group of apartments and homes for what is essentially a nighttime movie service; SHOWTIME or HBO provided. That **group** of customers is a **class;** buying one specific service. Now suppose we have another group of customers, doctors let us say, who buy a couple of hours a week for the sharing of medical data and procedures. They constitute another 'class' of service. Carry that on to as many groups or classes you care to dream up. Now apply the 'mystery phrase'. Perhaps what the phrase means is that the nighttime movie customers shall not be 'exposed to' the doctors's programs, and vice-versa. In other words there is security of programming material **between classes** of users or customers. But **no security** against outside unauthorized viewing by non-paying-customers.

This type of 'security' is really the ability to **''address''** specific customer classes or groups **on demand.** Most of the industry people feel this is the next big development field in MDS; addressable MDS terminals that can be turned on (and off) by remote control by the common carrier company. Several manufacturers in the field are working on a combination MDS antenna/converter/switching system that can be remotely addressed. The converter would run more or less full time but the output delivered at IF to the receiver(s) would switch on and off on cue.

The **concept** is neither new nor requring of much new technology. When the first MDS systems went into operation years ago most actually were installed with some form of 'class addressability'. For example, a coded message transmitted via the MDS transmitter is used to switch on and off a simple 'switch' which disconnects the **output** of the down converter from the downline. The converter continues to 'play' only nobody can see it working because the signal terminates (on the proper command) inside of the container itself.

''I'm not an engineer but I certainly felt sorry for the early pioneers with these external-to-down-converter boxes'' recalls the FCC's Richard Pullen. These extra boxes cost the MDS person at least $100 and often more each. **''Then it became evident that MDS was,** at that time, **primarily a one programmer service; that there was no need for the carrier to turn on and off groups or classes of programmer customers because there was only one class involved''.** So MDS carriers stopped the practice.

Now technology is catching up. Rather than building the addressable decode/switching into a **separate** box the manufacturers are working on a way to make it an optional module or set of parts inside of the masthead converter. **''Why should we go through the trouble and expense of providing a separate housing, a separate power supply, a separate PC board and many redundant parts to the converter when we can manage the addressable switcher decoder right inside the downconverter masthead unit or the downstairs unit?''** asks the MDS converter engineer. **''For a couple of IC's, and a handful of other parts I've got my decoder and switch in operation with the existing converter package.''**

There are at least three separate MDS down-converter manufacturers working very hard on this priority project right now. Each wants to be

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first. . .but more than first, each wants to be right.

Several design engineers in the field feel that as addressability becomes available as **a part of** the basic downconverter box there will be a noticeable rise in MDS receiver package pricing. The optimists in the crowd feel the extra cost of addressing will be in the $20 to $30 price range per site. The pessimists feel it may be far higher.

The Commission seems satisfied, for now, to employ gentle pressure to get the addressability package into the field, they recognize the boxes don't exist today, and that a hard mandatory position on making **all** MDS locations addressable would probably throttle the industry at a critical time. So the FCC constantly 'reminds' everyone that addressing 'is required' and the suppliers in turn are pulling out all of the stops to get it into production without shutting the industry down.

One supplier suggests that **"given another year or so we'll perhaps have MDS package down to a price range where the addition of addressing functions will bring us back to about where we are now."** If this is an accurate assessment of the time frame required, the next 12 months may well be critical to the survival of MDS.

A Learning Exercise

With the growing distribution of MDS transmissions the presence of the signals (and their 'pay-movie' programs) has attracted a considerable amount of interest in the electronics community. On the 'legal' side, many small cable systems located within service range of an MDS transmitter have discoverd that they can get a pay service into their cable systems for typically under $500 MDS to VHF conversion costs using stable, high quality equipment. That is certainly far less expensive than a TVRO although of course the number of program channels available is restricted to the single service brought in via the MDS.

On the not-so-'legal' side of the coin MDS technology is proving to be a very popular part-time activity for engineers and technicians in the communications world. Stories abound.

In the Washington, D.C. area complete MDS converter schematics and antenna designs are posted on bulletin boards in electronic emporiums, at electronic manufacturing facilities and several ad-hoc groups have purchased parts enmasse and conducted 'construction courses' to assist individuals in building their own MDS receiving systems. In Chicago, Philadelphia, Miami, Los Angeles (etc.) 'homebrew' MDS receiving systems are very much available on the 'black market'. One chap called CATJ last fall from Wisonsin. **"I purchased this satellite TV receiving system for $600 and it worked fine bringing in HBO for about two months. Then it quit. . .and now I can't find the fellow who sold it to me. Can CATJ help me get it fixed?"** he inquired.

Well now, a $600 "Satellite TV Terminal" would be the bargain of all time. Especially if it worked! On closer inspection we learned this fellow had been sold an "HBO Satellite TV Receiving System" which was in truth a MDS converter with a two foot parabolic antenna. After sorting it all out for the caller, we finally figured out he had been 'sold' a bill of goods; the "terminal" received HBO alright. . .but only **after** the HBO signal went through a very terrestrial MDS receiving package!

There is a popular story that says if you put up a privately owned MDS package on your home and intercept MDS broadcasts without being under contract to receive the service that you are violating section 605, breaking various laws and rules, and generally being a bad guy. MDS people propagate the story for good reasons.

What is the 'law' and how is it applied?

The MDS system has been likened to the domestic satellite system. FCC attorney Richard Pullen points out **". . .both are 'multiple address' services entitled to Section 605 protection".** Section 605 says that you shall not intercept any private (i.e. common carrier operated) transmission that is not intended (specifically) for you; and that if you should happen to so intercept (as in accidentally) the person making the unauthorized interception is not to (a) **divulge** what he intercepted, (b) **repeat** (as in relate) to any other party what he intercepted, and, (3) **profit** from the interception.

The Commission, at the urging of several concerned MDS licensees, recently issued a 'release' that spelled all of this out. One source at the Commission tells us that approximately a dozen letters have come to the Commission from citizens asking why they were told it was illegal to receive MDS transmissions. One of the favorite thought processes explored by such letters goes like this:

> **"If the MDS operator doesn't want me intercepting his transmission, then he can just keep his transmissions off of my property. When he figures out how to keep me and my family from being irridited by his** (damn) **microwave transmissions,** against our will, **then I'll stop looking at the transmission!"**

The Commission's Pullen (who heads up the legal department for the Domestic Common Carrier group) has a more practical approach to the 'problem'. **"First of all, I think the best security is the simple fact that we are dealing here with microwaves; and a low power microwave transmitter at that. All radio is, by definition, interceptible."**

The responsibility for providing "complete security of transmission" rests, in the Commission's view, with the carrier. That's what the rules state. The carrier could opt to scramble the transmission if he wished; there is nothing in the rules to prevent this. But there are two other problems with scrambling. One is the additional cost to the carrier and/or programmer renting time on the MDS transmitter. There is a one-time

cost of the scrambling equipment (i.e. the encoder at the transmitter) plus the on-going costs associated with providing descrambling (i.e. decoding) equipment at the authorized receive sites. So the **cost** of the equipment must be built into the service package. That may be tough to do on a private residence basis.

The second problem is one presented by the encoding equipment. The FCC requires that MDS transmitters be 'type accepted' which simply means that FCC's Laurel (Maryland) lab has to approve of the transmitter before it can be sold and operated. The transmitters available fall into two general categories. One group employs a traveling wave tube (TWT) for the final (10 watt power level) amplifier and the other family employs a triode type transmitting tube. To maintain a high quality output, the transmitter's final amplifier must 'stay linear'. Another way of saying this stage cannot distort the waveform passing through it from the lower power stages onto the antenna (or 100 watt amplifier). TWT's don't really like being linear and it doesn't take much to cause them to become non-linear. An extra carrier, such as a 'jamming carrier signal' will do it.

The TWT rigs dominate the field at this time but only because they were there first. The current breed employes triodes which their manufacturers (EMCEE, VARIAN, etc.) claim are much more linear. EMCEE, for example, specs the transmitter in operation **with** a scrambling signal present at about 7 dB better IM (intermod) than they did their previous TWT family of transmitters with**out** the scrambling signal present.

All of this simply suggests that if an MDS operator wants to jam or encode he has to start off with a triode transmitter design. There are several encoding schemes about. The least expensive and the technically simplest is the TEST jamming carrier; the same system hundreds of CATV system operators utilize for cable-secure pay products. An extra carrier, **placed inside the video passband** at a 'sensitive' spot creates interference to the video picture. To eliminate the interference requires a de-jamming box; a very high Q (and very stable) trap that 'sucks out' the jamming carrier while leaving the balance of the video passband alone. This extra (jamming) carrier drives TWT final amplifiers into intermod. **Plus there is a stability problem in the whole system.** The jamming carrier gets out of the system, at the receiver, only when it falls onto the precise frequency where the de-jamming hi-Q trap operates. If the MDS transmitter drifts (even within its tolerances), and/or if the down-converter drifts about (as they like to do), the jamming carrier moves off of the proper 'IF' spot and the de-jamming hi-Q trap no longer takes out the carrier.

Inspite of these problems, at least one MDS operator (Denver) had a run at this TEST approach. Nearly two years ago Denver put in a **pair** of (TWT) transmitters; one for the normal

MDS video/audio signal and a second devoted exclusively to the jamming carrier. The output of the two transmitters was 'combined' and fed to the antenna. The tests ran about 18 months or so; apparently they were less than successful because after 18 months when the MDS operator made a major facilities change and moved the station to a new location he dis-carded the approach.

The TEST system **is** utilized widely by MDS operators; only it is used **in apartment houses** and other installations where the MDS downconverted signal is distributed 'securely' within a building on cable. The scrambling/jamming takes place **only within the distribution system** within the apartment (etc.); the off-air signal is left intact.

Other encoding/decoding schemes are available from OAK Industries, Blonder-Tongue, and Motorola. Each of these is far more expensive to employ than the TEST system and most people within the industry feel none of these systems are cost effective for **private-residence** markets. As long as one decoder is required for say 50 or 500 outlets in an apartment building; no problem. But for each $10-a-month home. . .well, the numbers are not there. The OAK system is in operation in Houston and reportedly the purchase by TelePrompTer of the Chicago MDS operation will cause that MDS to become another OAK system.

SO. . .if MDS operators find low cost scrambling/jamming reasonably cost effective but it presents technical problems, and higher technology systems with video waveform inverting and the like are priced out of the range where MDS people believe they can afford the 'luxury' of security, what happens next?

At least one firm, Blonder-Tongue, has an answer.

"MDS systems should not **be pay movie machines. The FCC never intended for MDS to turn into a poor man's STV system and MDS should be prohibited from carrying pay movies into homes and apartment and the like".** You hear a lot of soul-searching amongst MDS suppliers and operators these days on this very issue. From their viewpoint pay movies have saved them from slow death. TEST's Paul Rebeles suggests **"This is just sour grapes. The industry needs to be left alone for another year or so to develop".** At least several FCC people seem to agree with Rebeles. FCC attorney Richard Pullen adds **"How in the world do you suppose a ten or even 100 watt (MDS) microwave transmitter is ever going to compete with a 5,000,000 watt UHF subscription television station? Anyone who has ever tried to put in an MDS installation knows the difficulties involved. The present generation of low-cost electronics and antennas for MDS require direct line of sight. The cost effectiveness of this type of installation falls apart very quickly when the installer must go to a tall tower, or a larger antenna, or more sophisti-**

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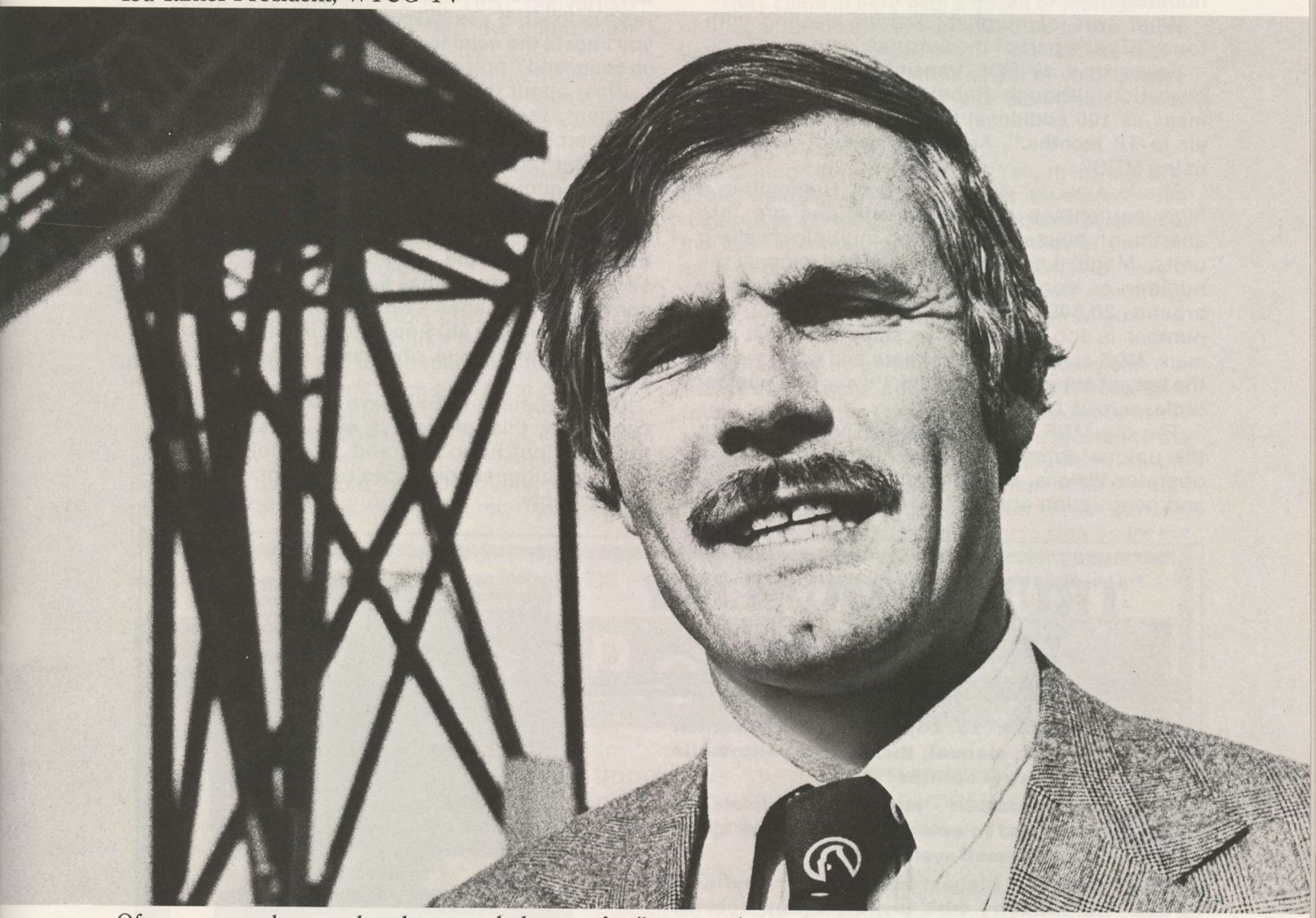

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cated electronics. There is no parity here with UHF STV and it was never intended that there should be.''

If Pullen represents a consensus of Commission thinking, then MDS people have nothing to worry about from the FCC. It does not appear the use-rule that presently allows MDS to transmit pay movies is going to change anytime soon. And time is on their side; there is strength in numbers.

What type of numbers are we dealing with, today? That's part of the surprise.

Fewer than 40 MDS transmitters are today in operation although Rebeles of TEST sees **''as many as 100 additional transmitters being on the air in 18 months.''** And the number of people using MDS?

That's a harder number to find. Remember, a high percentage of the installations are into apartment houses and other multiple-dwelling units. Magic Lantern's Doug Milne places the number of converter installations **''someplace around 20,000''**. TEST's Rebeles says that number is too low. **''We've shipped almost that many MDS converters out of here and while we are the largest supplier in the field, I'd say that number is closer to 25,000.''**

The big MDS news of the past year has been the unique approach of the Anchorage, Alaska operator **Visions.** By installing an earth terminal and negotiating contracts with **multiple** program suppliers (HBO, Madison Square Garden, WTCG, FANFARE and others) Visions has put together a **24 hour per day** program service for their MDS customers; who are predominently individual residences. The number is well beyond 12,000 and growing still. Visions is a hybrid operation, not simply a re-broadcasting service for HBO.

''I think if more MDS programmers took the Visions approach, programming a full broadcast day, the question of addressability would largely resolve itself. If you have one 'class' **of customers you negate the need for addressing specific groups on command''** notes one FCC person.

What about the other side of the MDS security problem; the 'bootlegging' of equipment from commercial sources or the construction of MDS converter packages? Just how concerned is the industry about this?

Doug Milne at Magic Lantern sees the problem as critical.'' **''We simply will not sell hardware to people we do not know. The best security this industry has today is the control of its converter packages. I'd be out of business overnight with my MDS operators if I started selling converters to anyone who came in here with the money.''**

Paul Rebeles at TEST says **''We are very much concerned; this, afterall, is our industry''.** TEST recently instituted a brand new policy which Rebeles suggests he hopes other converter suppliers follow:

1) "We have gone out to every customer we have sold to in the past and asked each of them to provide us with a letter from their common carrier which authorizes them to be utilizing the common carrier's service and signals."
2) "When this new program is finished, shortly, we will have a coded customer list which separates those who have this letter on file and those that do not. After a cut-off date, any new orders for TEST converters that do not match up with the coded customer list will be turned back."

There are people out there building MDS converters who don't have the ethics of Milne and Rebeles of course. One true story should suffice.

A national sales manager for a large, well known cable equipment supplier got a telephone call from a VP of engineering at a major MSO.

"Tell that (name of person) **to knock off selling MDS converters on the street or we are going to stop buying CATV gear from you".**

The cable equipment supplier did not (and does not) manufacture MDS gear. The MSO VP works for a company that also owns MDS transmitters. Unbeknownst to the manufacturer, one of the 'senior technicians' was operating a 'garage business' with a couple of other employees producing around 200 MDS units a month. The units were being shipped into the 'blackmarket' sector and were sold to individuals. His employer, the CATV gear manufacturer, had no idea this was going on.

"Phoenix (Arizona) **is the worst MDS theft market in the country today"** says the FCC's Pullen. **"I guess that large concentration of electronic manufacturing companies,** especially Motorola, **in Phoenix is the reason."**

The Phoenix MDS operator thought he could go to the FCC for help. He engaged outside help in running down the 'core' of the Phoenix 'illegal' MDS converter business. Then they went all over Phoenix taking pictures of non-authorized MDS antennas and converter boxes sitting atop masts and chimney mounts.

"They came in here with a dozen or more photos of 'illegal' **installations and asked us to prosecute these people"** reports Pullen. **"My favorite was a four foot parabolic constructed out of chicken wire and the feed on the 'dish' was a Budweiser beer can!".**

What did the FCC do?

"Nothing" reports Pullen. **"Yes, there is a probable violation of 605 here but to enforce 605 requires us bringing in the Department of Justice, the local marshall, and spending alot ot time on each case."** Time costs money. However, would not handpicking a few cases for their maximum publicity impact accomplish the desired goal?

"Perhaps. And perhaps it will eventually come to that. But for right now, and for the foreseeable future, we urge the operators to handle these cases locally through civil prosecution. I suggested to the Phoenix people that if they simply went to the person's door and presented them with the fact that they were stealing a common carrier service, and gave the thief the opportunity to sign up for the service and pay the nominal ($10) charge per month as an option to being dragged through court and

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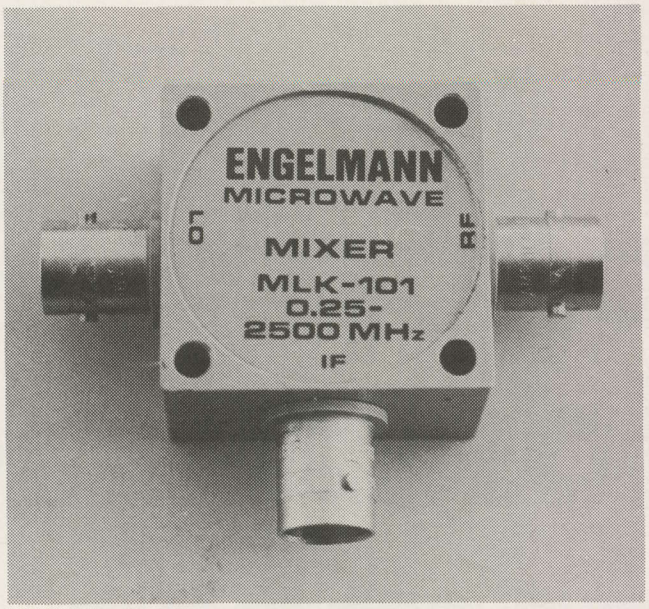
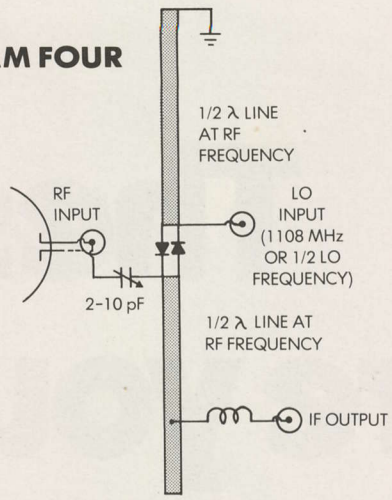


JUST A MIXER is all that is required if you have an LO (local oscillator) source and a tuned antenna system. This ($100 range) commercial mixer will do the job when mated with a high side LO and antenna.

DIAGRAM FOUR



TWIN DIODE MIXER USES 1/2 FREQUENCY LOCAL OSCILLATOR, REQUIRES RELATIVELY LOW LO SIGNAL, AND IS NOT CRITICAL TO TUNE WITH 20% BANDWIDTH

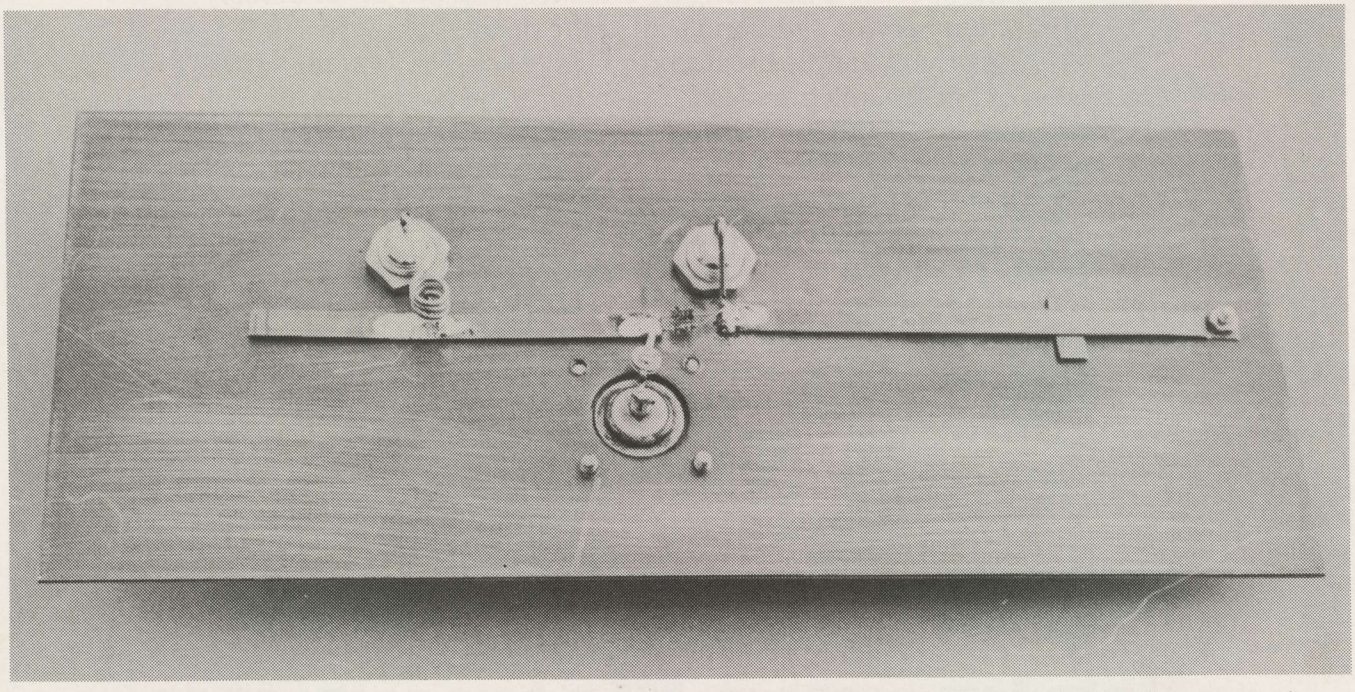
having their equipment confiscated, that I thought most people would opt for the monthly fee''.

There are of course civil remedies available. An individual suspected of stealing MDS can be brought to court to answer charges. Paul Rebeles says this is a dangerous area however because you may end up with a reverse precedent.

''I know of several cases, perhaps 2 or 3, where the operators gathered the evidence and filed charges. Then the (local) **judge threw the case out of court because he didn't understand 605. That is one of the reasons the operators got the FCC to issue their recent statement on 605 and MDS; to give the operators something they could hand to a** (local) **judge. I don't blame a judge that deals with divorce or other civil matters not understanding this law. Even many communication attorneys don't understand it.''**

There is alot of hand wringing amongst operators on this issue.

Would the FCC prosecute under 605 criminal sanctions under **any** circumstances? ''We might if it got bad enough''. How bad is bad enough?



SIMPLICITY MDS 'converter' consists of mixer utilizing Microwave Associates diodes in mixer/doubler circuit, with resonant strips suspended above G-10 copper PC board. Output connect top left is i.f., center is LO (local oscillator), **bottom center is RF input. See text for description.**

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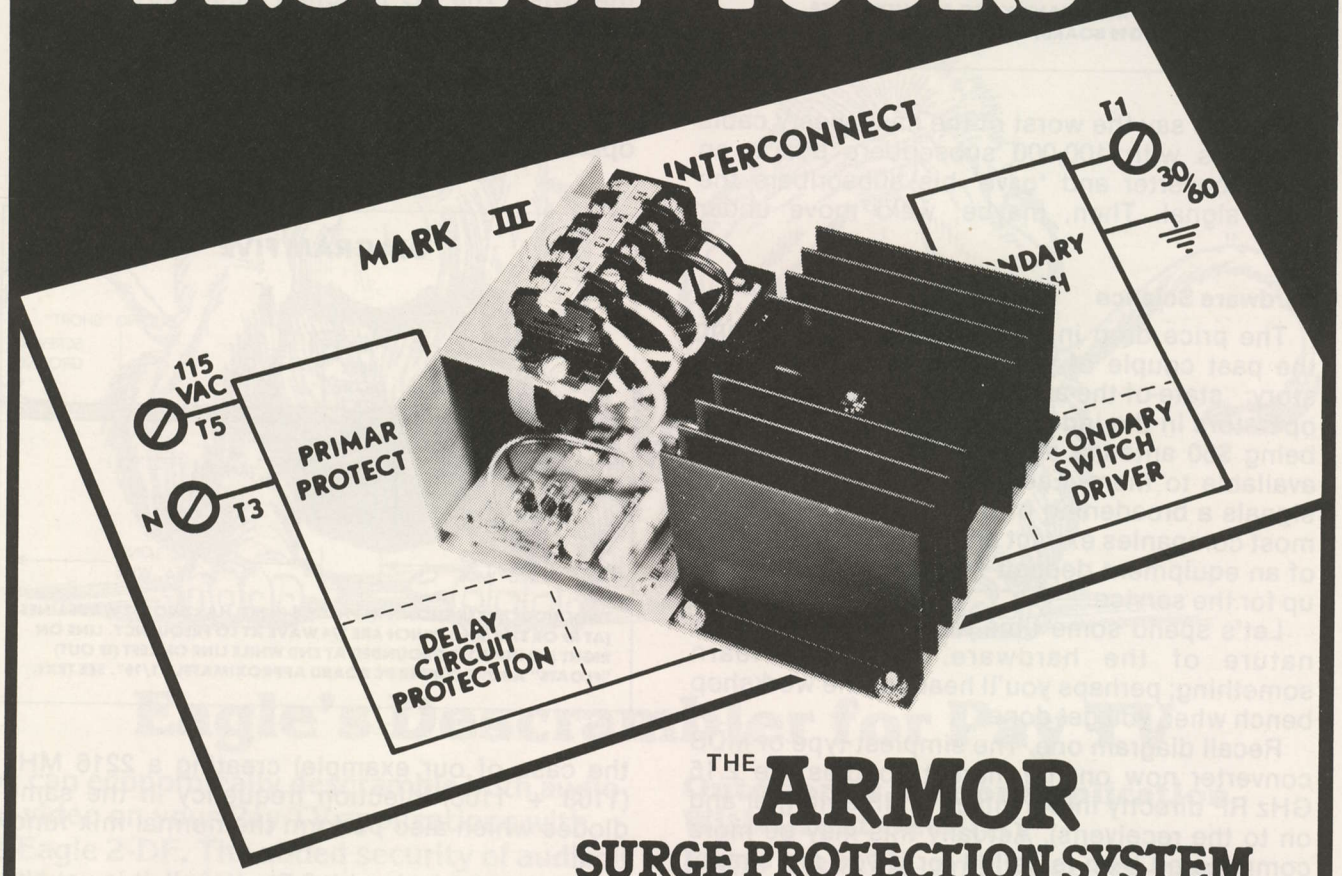

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THE ARMOR MARK III is a self-protected device for providing surge overvoltage protection at each powering location. Each MARK III contains a preset time delay which ultimately controls time from primary line application to constant voltage transformer output.

SPECIFICATIONS:

Electrical: *Working Voltage:* 30—60 Vrms constant voltage transformer output; *Switching Current:* 25 Amp rms maximum; *Surge Capacity:* 10,000 A peak; *Primary Interrupt:* Thermally activated, self-resetting, 10 Amp circuit breaker backed up by a 30 A fuse; *Secondary Delay:* User specified, 3 seconds standard; *Operating Temperature:* —25° C to + 125° C.
Mechanical: *Mounting:* Single ¼" bolt. *Interconnection:* Two, 4 pin connectors.
Accessories: Preassembled interconnecting harness with 18" leads, waterproof housing to facilitate external mounting.

MARK III may be installed into most existing power supply housings such as Sola, Vikoa, Glentronics (Sawer Industries), later version Jerrold, Sylvania. Early Theta Com, Jerrold, some Ameco models do not provide adequate space, requiring external waterproof housing.

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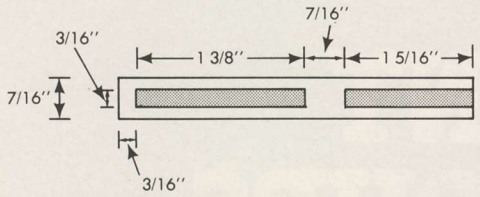
DIAGRAM FIVE-A



ETCHED ON CIRCUIT BOARD 1/2 WAVELENGTH LINES FOR TWIN-DIODE MIXER. DIMENSIONS REFLECT OPERATING SYSTEM EMPLOYING AVANTEK VTO-8090 MIXER. USE DOUBLE-SIDED G10 BOARD.

Well, let's say the worst of the nasty-nasty cable operators with 100,000 subscribers put in an MDS converter and **'gave'** his subscribers the MDS signal. Then, maybe, we'd move under 605. . .".

Hardware Science

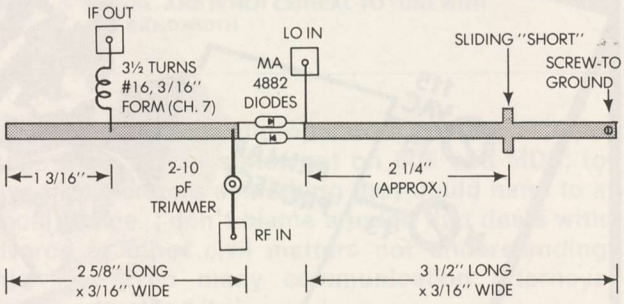
The price drop in MDS receiving gear during the past couple of years pretty much tells the story; state-of-the-art is still to come. MDS operators in the industry talk of there eventually being $50 antenna and converter combinations available to them. Each drop in converter price signals a broadening of their market base since most companies extract an 'entry fee' in the form of an equipment deposit from the home signing up for the service.

Let's spend some time looking at the current nature of the hardware. You may learn something; perhaps you'll head for the workshop bench when you get done.

Recall diagram one. The simplest type of MDS converter now on the market couples the 2.15 GHz RF directly into a mixer, an IF amplifier and on to the receiver(s). Actually this may be more complicated than is called for if you are simply out to see how it is done, and learn for yourself that 2.15 GHz is not that exotic anymore. Reference **diagram four.** This is a relatively new device approach first popularized by some engineers at Microwave Associates where microwave diodes are designed and manufactured. It is called a "twin-diode mixer" and it has a couple of interesting things going for it.

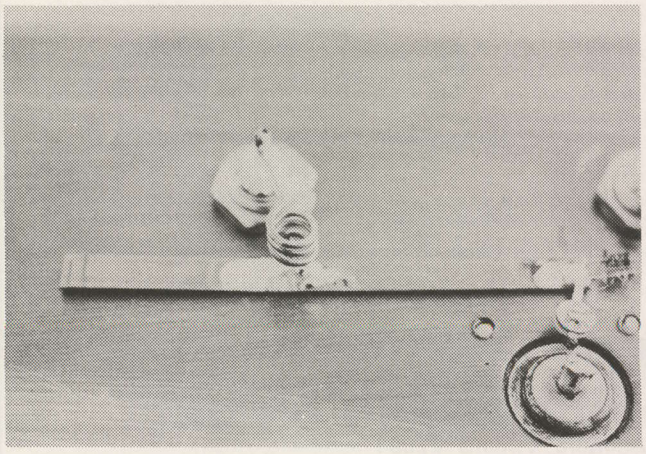
What we have here is a pair of idential (although 'matching' is not necessary) microwave diodes connected in a parallel mode with polarities reversed. The diodes are suspended (in air) across two ends of 1/2 wavelength 'resonant lines'; the lines are operating at the LO-mixer input frequency. However, here is the twist. The LO injection frequency is at **1/2 the normal LO frequency** and the diodes operate separately. In one half of the RF cycle **one diode turns on** while in the second half of the cycle **the opposite diode turns on.** Thus we have two diodes operating with a 1/2 frequency LO (1108 MHz in the case of our example) creating a 2216 MHz (1108 + 1108) injection frequency in the same diodes which also perform the normal mix function.

DIAGRAM FIVE

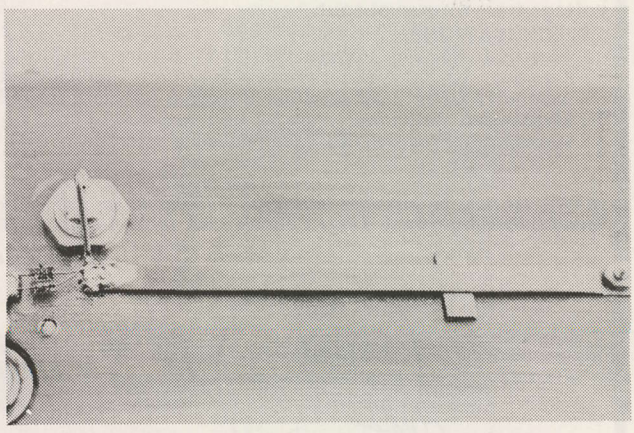


TWIN DIODE MIXER SHOWN IN PHOTOS (HERE) HAS TWO 1/2 WAVE LINES (AT RF OR 2150 MHz) WHICH ARE 1/4 WAVE AT LO FREQUENCY. LINE ON RIGHT (LO INPUT) IS GROUNDED AT END WHILE LINE ON LEFT (IF OUT) "FLOATS" ABOVE COPPER PC BOARD APPROXIMATELY 1/16". SEE TEXT.

Why is this desireable? First of all, it is usually far less difficult (and expensive) to create a 1100 MHz range oscillator source than it is to create a



I.F. output tap on elevated-strip line mixer with (channel 7) output coil. Strip is suspended above copper clad PC board and 'tuning' consists of both height above board of strip (supported by i.f. coil) **and tap point for i.f output coil.**



2.32 GHz LO input (LO through upper left connector). **Input link is directly tied to end of copper strip; diodes mount between two copper strips. Tuning of the strip line resonant frequency is accomplished by shorting strip to ground with 'shim' of copper. Far right end is DC/RF grounded. See text.**

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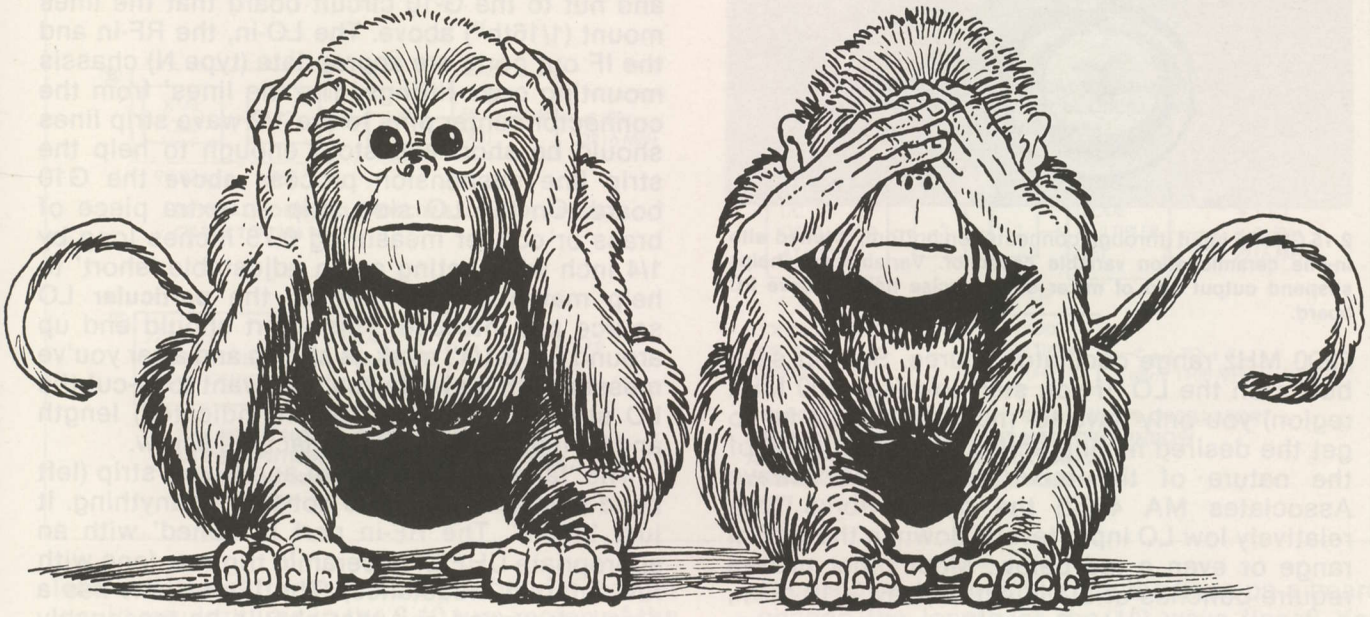

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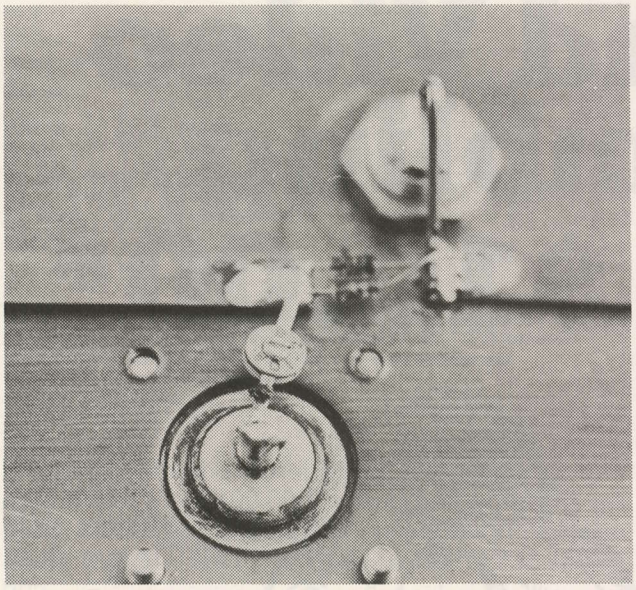


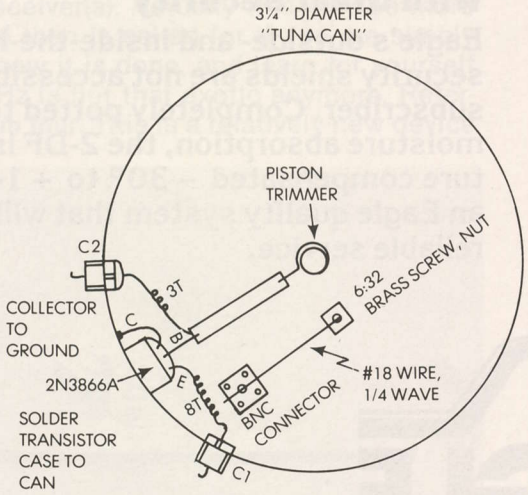
2.15 GHz RF input (through connector on bottom) **is tuned with in-line ceramic/teflon variable capacitor. Variable cap helps suspend output end of mixer strip precise height above PC board.**

2200 MHz range oscillator source. So you save bucks on the LO. If you start low (say 100 MHz region) you only have to 'multiply' **half as far** to get the desired mixing action. Next, because of the nature of the mixer diodes (Microwave Associates MA 4882) the mixer works with relatively low LO input levels; down in the 0 dBm range or even a tad below. Most other mixers require bunches of LO injection, say +10 dBm, to function properly. So that's another savings; **less LO 'power' required.** And the mixer 'noise figure' (or conversion loss) is typically very good (as mixers go); in the 6 to 6.5 dB range.

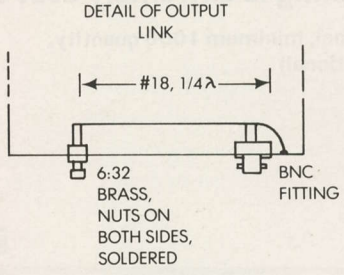
There are other advantages to this approach as well. There is virtually no tuning required because the circuit is quite broadband; +/– 10% (215 MHz either way at the input RF frequency) without difficulties. And it is very simple and repeatable.

In **diagram five** we have a do-it-yourself diagram of the same twin-diode mixer. Construction time should be about 15-30 minutes. The two 1/2 wave (at 2.15 GHz) lines are some hardware store brass or copper stock cut to the appropriate dimensions. The LO in line (right hand side on drawing) is grounded with a machine screw and nut to the G-10 circuit board that the lines mount (1/16th") above. The LO-in, the RF-in and the IF out ports are appropriate (type N) chassis mounting coax fittings. The 'tie lines' from the connector center pins to the 1/2 wave strip lines should be short and stout enough to help the strip line suspension process **above** the G10 board. On the LO side strip an extra piece of brass or copper measuring 0.75 inches long by 1/4 inch wide acting as an adjustable 'short' to help match the LO line to the **particular** LO source put into use. This short should end up around the 2-1/4" mark as shown and after you've messed with it awhile you may want to re-cut the LO strip to the proper (short indicated) length and tie it down with a new machine screw.

The 'far end' of the RF-in and IF-out strip (left hand side of drawing) is not tied to anything. It just 'floats'. The RF-in port is 'tuned' with an appropriate UHF/SHF ceramic trimmer (one with low internal inductance). The IF-out port has a small air wound coil that should be reasonably resonant with the IF output frequency chosen. The 3-1/2 turn, 3/16" form shown in the diagram is for channel 7; higher channels would require



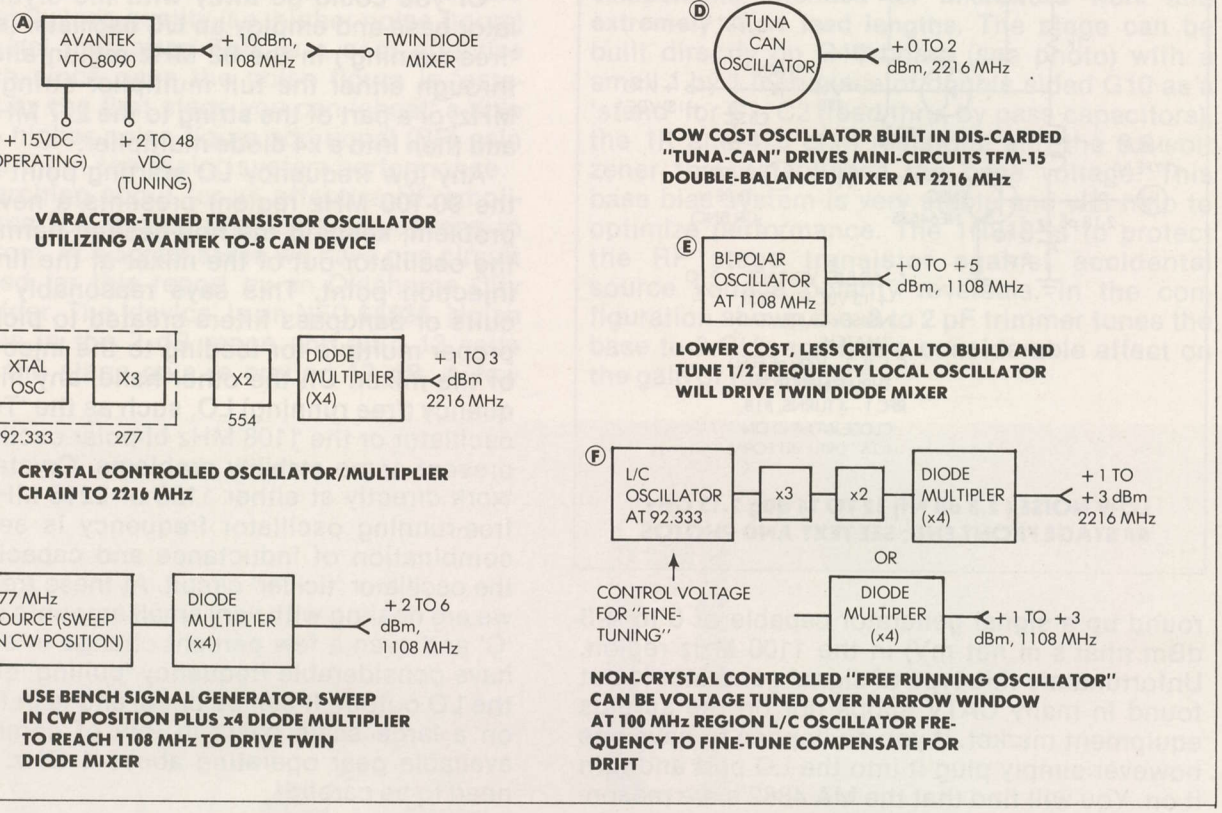
TUNA CAN LOCAL OSCILLATOR



LINE IS TAPPED AT
1/4 WAVE, WITH BNC
FITTING CENTER PIN, GROUNDED
BOTH ENDS.

2ND HARMONIC OSCILLATOR, TUNES 1100 TO 2300 MHz.
ALL CONSTRUCTION TECHNIQUES MUST FOLLOW UHF PRACTICES WITH VERY SHORT LEADS, CAREFUL CONSTRUCTION

DIAGRAM SIX



less coil (fewer turns) while a low band IF output would require turns in the 8-10 turn region of the same diameter.

Tune up is simple. Connect an LO source (such as a signal generator, a sweep in the CW mode, even the 'selected' harmonic of a signal generator or sweep) to the LO source port. Connect an antenna (more about this shortly) to the RF input port and either a FSM or a TV set to the IF output port.

1) With **some** signal indicated tune the 2-10 pF trimmer on the RF input for maximum indicated signal.
2) Very carefully adjust the shorting bar and then the spacing between the strip lines and the G10 copper board below for best levels.

Does it work? Well, with 6 to 6.5 dB conversion loss whatever level you have at 2.15 GHz (from the antenna) will be 6 to 6.5 dB 'down' at the IF frequency. Say you have 100 microvolts at 2.15 GHz (– 20 dBmV). The IF output will be down in the 50 microvolt region. A little grainy perhaps, but watchable. You won't set any distance records with this but the cost will be at or under $5.00 if you acquire the MA 4882 diodes on the open market.

Must the strip lines be suspended above a ground plane? Yes. Could they not be 'etched' onto a double sided G10 board with the copper left on the 'opposite side' to form the ground plane? Yes again. You'll see a photo here of just such a circuit. Does placing the lines on a board change the length of the 1/2 wave lines? Yes again. See **diagram five-A.**

The LO Source

While virtually anyone can put together the diagram five or five-A mixer and an antenna (diagrams 11, 12 and 13 coming up) what about the LO? There are many-many possibilities here, a few of which are shown in **diagram six.** Perhaps the easiest method of creating an LO is to simply

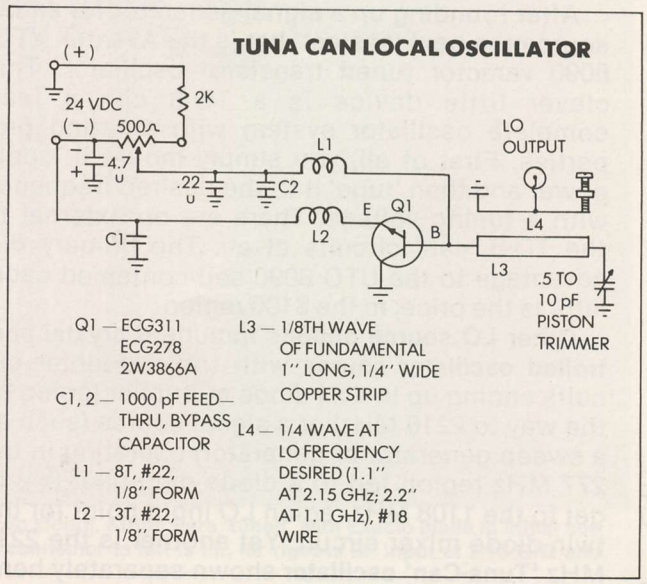
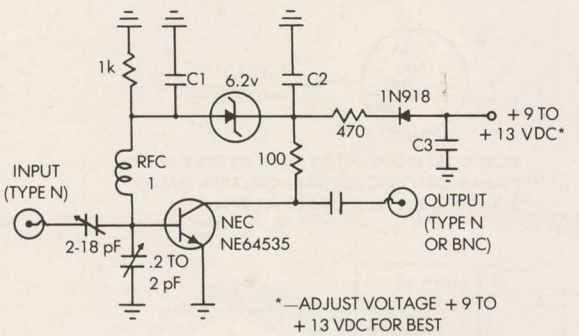


DIAGRAM SEVEN



*—ADJUST VOLTAGE +9 TO +13 VDC FOR BEST NOISE FIGURE, GAIN "MATCH"
C 1, 2, 3—1000 pF FEED THRU CAPACITORS
RFC 1—4 TURNS, #18, CLOSE WOUND ON 1/16" DRILL BIT FORM

LOW NOISE (2.3 dB Nf) 12 TO 14 dBg 2.15 GHz RF STAGE FRONT END; SEE TEXT AND PHOTOS

round up a signal generator capable of 0 to +3 dBm (that's **m** not mV) in the 1100 MHz region. Unfortunately this type of signal generator is not found in many CATV shops nor on the surplus equipment market. If you do happen to have one however simply plug it into the LO port and turn it on. You will find that the MA 4882's are reasonably tolerate the LO level but you will want to stay in the prescribed LO drive **region.** Are there some other microwave diodes (other than the MA 4882) that will function in this circuit? Yes again. HP has several in their diode line (which experiments reveal require some changes—minor—in the line lengths) and there are others as well. However, of many-many different microwave diodes checked out in this circuit the MA 4882 diodes gave the best performance (i.e. lowest conversion loss) with a several dB difference between this particular diode and the 'next best' tried.

After rounding up a signal generator for an LO source the next 'easiest' bet is the Avantek VTO-8090 varactor tuned transistor oscillator. This clever little device is a TO-8 can 4 lead complete oscillator system with amazing properties. First of all, you simply mount it, apply power and then 'tune' it to the desired frequency with a tuning voltage. There are no external to the TO-8 'can' circuits at all. The primary disadvantage to the UTO 8090 self-contained oscillator is the price; in the $100 region.

Other LO source options include a **crystal controlled oscillator source** with tripler/doubler circuits ending up in a x4 diode multiplier (going all the way to 2216 MHz) or a signal source (such as a sweep generator or generator) operating in the 277 MHz region fed to a diode multiplier (x4) to get to the 1108 MHz region LO input point for the twin-diode mixer circuit. Yet another is the 2216 MHz **'Tuna-Can' oscillator** shown separately here, or a similar (bi-polar) oscillator operating at 1/2 frequency (1108 MHz region) to be fed into the twin-diode mixer.

Or you could do away with the crystal oscillator base and employ an **L/C oscillator** (so-called 'free running') in the 92 MHz region and feed it through either the full multiplier string to 2216 MHz, or a part of the string to the 277 MHz region and then into a x4 diode multiplier.

Any low frequency LO starting point (such as the 90-100 MHz region) presents a new design problem; keeping the non-desired harmonics of the oscillator out of the mixer at the final mixer injection point. This says reasonably hi-Q circuits or bandpass filters created to pick off the proper multiple for feeding to the injection port of the mixer. On the other hand, any higher frequency (free running) LO, such as the 'Tuna-Can' oscillator or the 1108 MHz bi-polar oscillator will present some **stability** problems. Crystals won't work directly at either 1108 or 2216 MHz so the free-running oscillator frequency is set by the combination of inductance and capacitance in the oscillator 'tickler' circuit. At these frequencies we are dealing with very small amounts of 'L' and 'C' and even a few percent change in either will have considerable frequency 'pulling' effects on the LO output. It can be done, and is in fact done on a large scale basis in lots of commercially available gear operating above 1 GHz. But you need to be careful!

RF Gain

Getting some gain into the system is important. And so is lowering the overall noise figure of the conversion package. A reasonably high quality RF stage does both of these things.

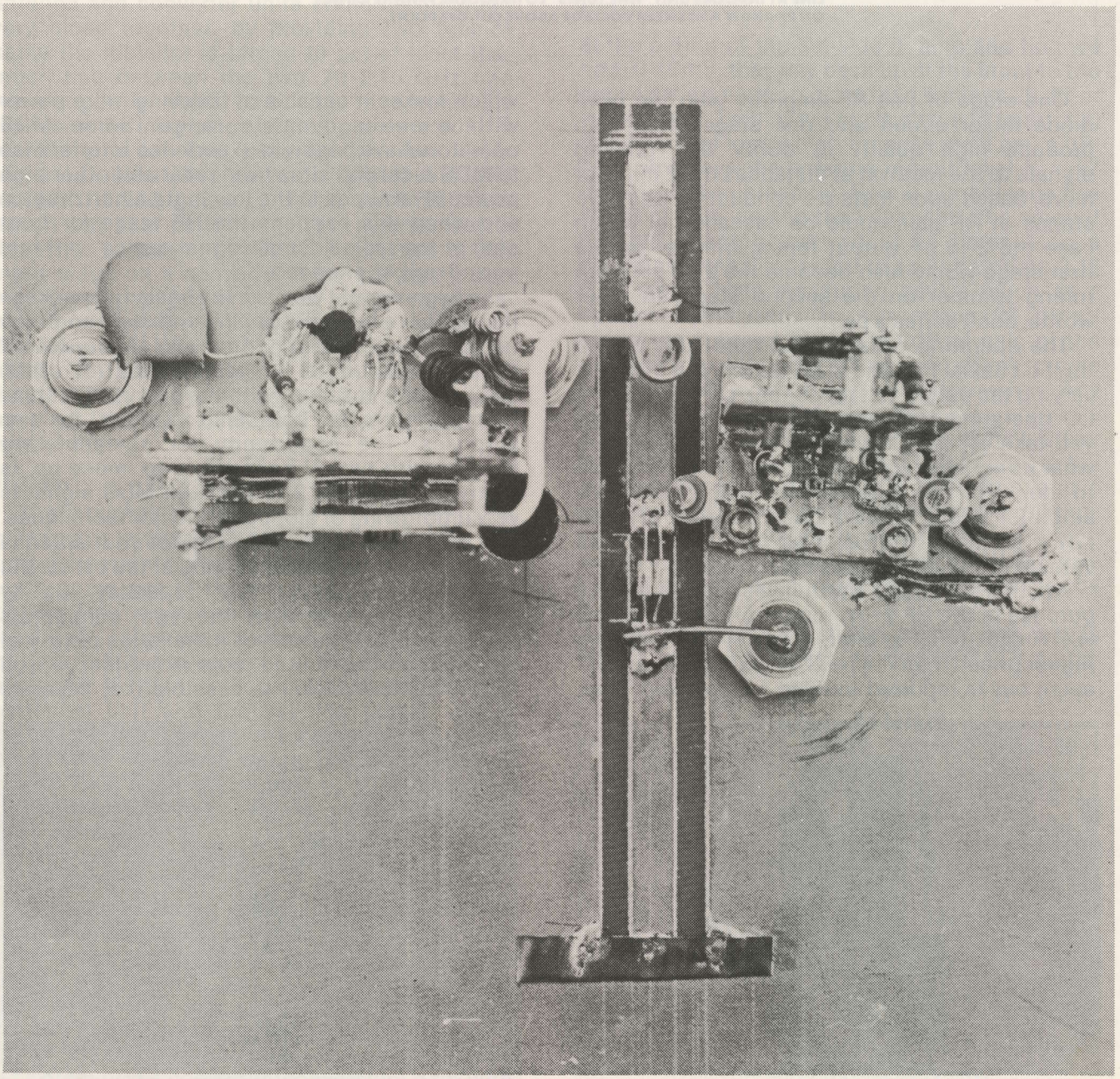
The primary questions become:

1) How much RF gain should I use, and,
2) What are the trade offs between noise figure and costs?

Commercial units employ from one to three RF stages. If you figure there is from 8 to 12 dB of gain per stage (dependent upon the transistor device selected and the design of the stage plus the care in construction) that says that from **24 to 36 dB of gain is the maximum found in commercial units.** Typically the RF gain stages contribute no more than 25 dB of actual voltage gain to the system in a **very exotic** converter. Too much gain raises other problems. The mixer, for example, requires LO injection drive in some reasonable proportion to the amount of RF drive supplied. This won't be a problem with most mixers since their (dynamic) range is good enough to handle most anything you are likely to create. However some mixers function 'better' (i.e. more efficiently) when the amount of RF drive and the amount of LO drive is properly proportioned. This says that you may need some way to increase LO drive if RF gain gets high, or alternately, some way to optimize LO drive for best signal to noise ratio (or best looking picture).

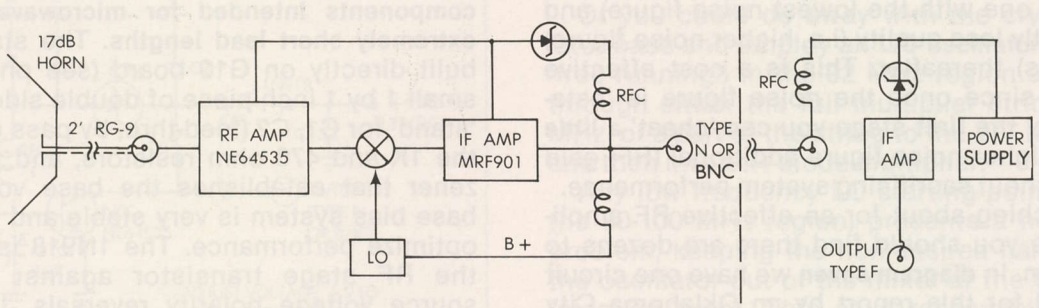
Most commercial units with two or more RF stages employ a 'quality' transistor as the first stage (i.e. one with the lowest noise figure) and then **slightly** less quality (i.e. higher noise figure) RF stage(s) thereafter. This is a cost effective approach since once the noise figure is 'established' by the first stage you can 'cheat' **a little** and use higher noise figure additional (RF) gain stages without sacrificing system performance.

In searching about for an effective RF amplifier device you should find there are dozens to select from. In **diagram seven** we have one circuit developed for this report by an Oklahoma City area builder. The 'device' is an **NEC 64535.** Noise figures is in the 2 dB range and with 13 volts applied the stage gain is around 13 dB. A few notes about the circuit. First of all, SHF construction practices are a must. That means **components intended for microwave work** and **extremely short lead lengths.** The stage can be built directly on G10 board (see photo) with a small 1 by 1 inch piece of double sided G10 as a 'stand' for C1, C2 (feed-thru, by pass capacitors), the 1K and 470 ohm resistors, and the 6.2 volt zener that establishes the base voltage. This base bias system is very stable and will help to optimize performance. The 1N918 is to protect the RF stage transistor against accidental source voltage polarity reversals. In the configuration shown the .2 to 2 pF trimmer tunes the base to 2 GHz and has a considerable affect on the gain of the stage.



MODERATE GAIN MDS converter constructed on G-10 circuit board (two sided). **Strips were 'tuned' with Exacto blade in initial cut-and-try exercise although final dimensions are given in text. Output connector to left is i.f., far right is RF input at 2.15 GHz and lower right is LO.**

DIAGRAM EIGHT



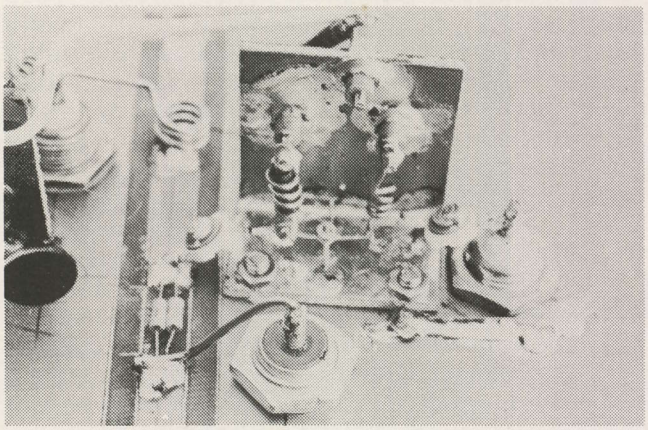
BASIC FULL PACKAGE — HORN ANTENNA WITH 24" RG-9 JUMPER, RF AMP/MIXER/LO/IF AMP IN OUTDOOR MASTHEAD BOX; IF AMP AND POWER SUPPLY INDOORS. OPERATING VOLTAGE IS CARRIED ON COAX LINE TO CONVERTER, RF CHOKES KEEP RF AND B + SEPARATED. POT ON B + LINE AT INDOORS UNIT "FINE TUNES" LO (FREQUENCY) WHILE ZENERS ON RF AND IF AMPS KEEP VOLTAGE ABOVE CUT-OFF POINT.

One stage of this RF amplifier with the twin-diode mixer circuit and one stage of IF gain produce high quality (0 dBmV and greater) signals to the receiver at distances of 22 miles or more; based upon tests we conducted. Still, two stages of RF gain could be cascaded in which case the 2-18 pF output tuning trimmer on the first stage would also become the 2-18 pF input tuning trimmer on the second stage. In other words, don't series a pair!

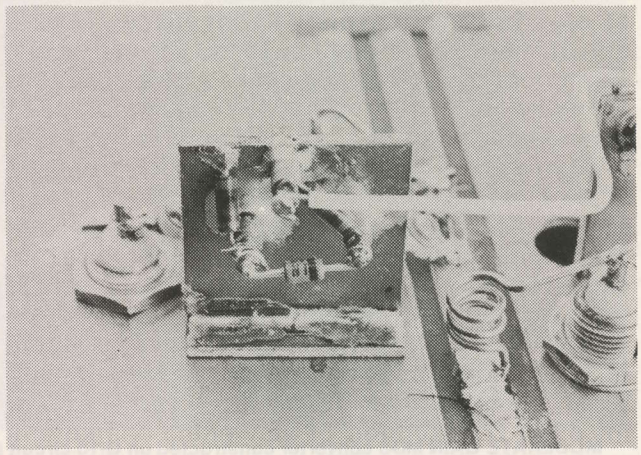
The operating voltage would probably be fed up the coaxial line and chances are you might be varying the upline voltage to tune or fine-tune the LO operating frequency. Depending upon how you take off the LO voltage tuning voltage and what its voltage is you might have to zener down to the 13-14 volt range for the stage itself. The amplifier circuit gives a good account of itself down to the 9 volt level as long as the base voltage is stabilized at the 6.2 volt level.

Another transistor worth investigating for this purpose is the **HP 2101**; reportedly a 'cull' of the HXTR 6101 (4 GHz) bi-polar family. It is slightly higher priced than the NEC 64535 ($18 versus $17 each) but is reported to have a large chip 'area' which makes it capable of handling more power with a better dynamic range. Some MDS operators have begun to experience interference to MDS receiving sites from radar and other high power RF sources in the lower gig-a-hertz region and when this happens the RF stage (or front end) of the typical 'small signal device' will fold up and quit; overloaded.

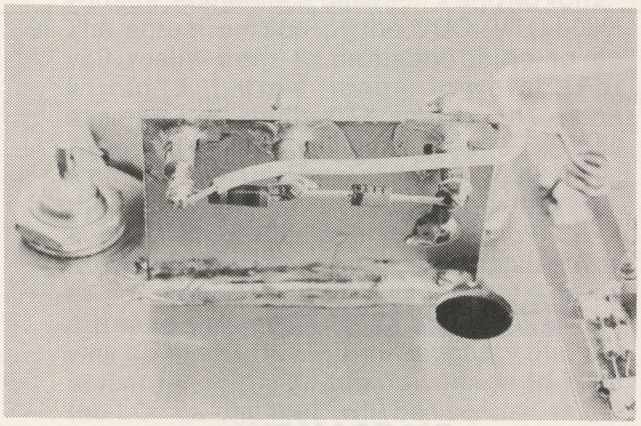
In **diagram eight** we have the basic full package that we have been describing and shall continue to describe. Most commercial converter suppliers include a jumper of RG-9 (or other) coaxial cable made up with the appropriate (type N) connectors on both ends. This is for two purposes. The opportunity for someone not familiar with type N connectors to 'mess up' is pretty good and at 2.15 GHz the MDS signal is very unforgiving of sloppy connector techniques. You can lose a high percentage of your antenna 'power' just by improper seating of the center pin on the connector at this frequency. So by providing a cable with the two connectors already in place, this saves installation crew foul ups and call backs. And there is another reason for the cable. While it is possible that separate



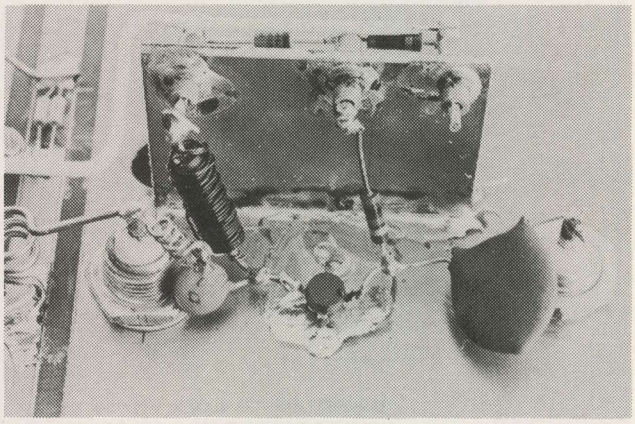
RF INPUT stage on moderate gain 2.15 GHz MDS converter utilizes low noise transistor RF stage, strip line techniques, MA mixer diodes in frequency doubling circuit (see text).



BACKSIDE of RF amplifier stage in moderate gain 2.15 GHz MDS converter.



BACKSIDE of i.f. amplifier stage powering in moderate gain MDS converter.



OUTPUT side of MDS converter with single stage transistor i.f. amplifier (between two connectors). **Connector at left is i.f. output prior to i.f stage amplification while connector on right is after i.f. amplification.**

antenna and converter units could be mounted very close together, by providing two feet of cable the installer is forced to get at least that much line between the two. At 2.15 GHz one wavelength in solid coax line is around 2.6 inches. A 24 inch piece of line places around 9 wavelengths of line **between** the two units (antenna output and converter input) and this amount of line helps to 'force an impedance match' to the converter. This means that a sensitive-to-input-impedance mis-match RF input stage on a converter is less likely to 'run wild' (as in oscillate or go 'flat') because of mis-match; the relatively speaking 'long' length of line takes care of that. There is a message here; unless you are prepared to adopt careful impedance matching systems at the first stage input, keep a 2 foot hunk of RG-9 or something similar handy!

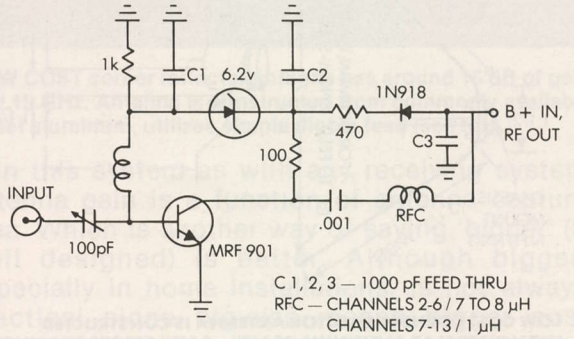
IF Gain

The intermediate frequency (IF) is going to be someplace between 50 and 300 MHz most of the time (although some of the newer commercial units come out in the low end of the UHF TV band). This means you need **some gain** in a frequency range where most cable people feel quite comfortable. In most applications you will want the IF gain split between the masthead (antenna) unit and the set-side power supply (although, again, if you are going to put it 'one place' the masthead would be the preferable spot). This suggests a **pair of IF gain stages** through which even if you select low gain devices is going to amount to at least 8 dB per stage. With careful selection of devices the gain in each IF stage can approach the 13 dB mark.

Let's back that up abit. Assume the **RF stage** has **13 dB** of gain and you have two **IF stages** each with **10 dB** of gain. That is a **total voltage gain of 33 dB** (13 + 10 + 10). That is **not** the 'conversion gain' of the package however; we have to subtract out the loss (so-called noise figure) of the mixer. Allowing 7 dB for that, we end up with 33 – 7 or 26 dB of converter (conversion) gain with the configuration shown in diagram eight. That says that if we measure the IF output signal level at the output of the set-side IF amp and find we have 0 dBmV, that way back up at the input to the converter we have no more than 0 minus 26 dB or – 26 dBmV. To that we must also add (subtract) the downline loss which for ease we'll call 1 dB. That now says the antenna output level is – 27 dBmV (or 45 microvolts). Now if our antenna has 13 dB of gain we can then calculate the amount of field strength that would be present on a dipole antenna connected to an appropriate 2.15 GHz signal level measuring device (such as a spectrum analyzer). To our minus 27 dBmV signal we subtract out the 13 dB of gain of the antenna and that puts us at – 40 dBmV dipole signal level; a whopping 10 microvolts! Any CATV type knows that 10 microvolts across a dipole is not much to begin with (Arizona's Oliver Swan being the exception) and that begins to tell you how important a good 'low noise' front end is in this service. Remember RF voltage amplification is not worth much if we are fighting a high noise figure to begin with; both the noise-figure 'noise' and the weak signal get amplified in the same proportion.

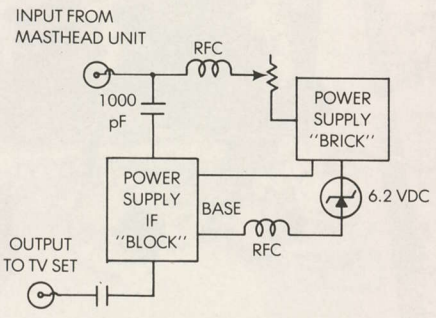
The IF gain stage shown in **diagram nine** is unlike any you are likely to find in CATV equip-

DIAGRAM NINE

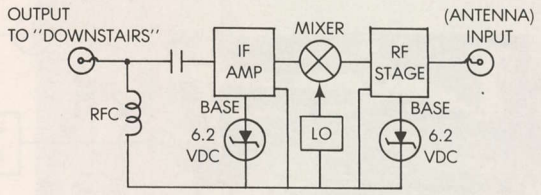


C 1, 2, 3 — 1000 pF FEED THRU
RFC — CHANNELS 2-6 / 7 TO 8 μH
CHANNELS 7-13 / 1 μH

IF AMPLIFIER WHICH REQUIRES NO TUNING, CAN BE UTILIZED BOTH AT MASTHEAD AND WITH INDOOR UNIT



"DOWNSTAIRS" IF BLOCK, POWER SUPPLY POWERING CONNECTIONS



UPSTAIRS MASTHEAD CONVERTER WITH POWERING CONNECTIONS

DIAGRAM TEN

ment and therefore it is instructive. It was designed for an MDS converter project and it has most of the physical appearances of the 2.15 GHz RF gain stage. Only the device is different ***(MRF 901)*** and the tuning is eliminated. This particular approach gives a good (i.e. low) IF noise figure; a consideration in system design since we don't want to ruin an otherwise well performing system with a high IF noise figure. Again, follow good VHF-UHF construction practices using very short leads and compact construction.

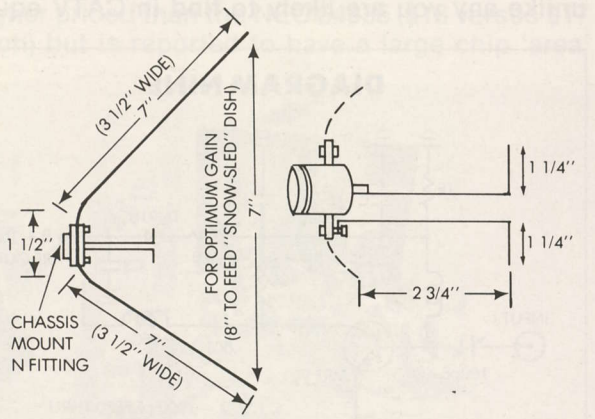
Two photos show the stage is built directly to the G10 circuit board with the same use of a small piece of 'standup' G10 double sided board to mount the 1000 pF feed through, by-pass capacitors and some of the powering associated parts. The two RF chokes in the circuit are selected based upon the IF output frequency (range) selected. Gain is in the 10 dB range; noise figure under 1.5 dB.

Powering

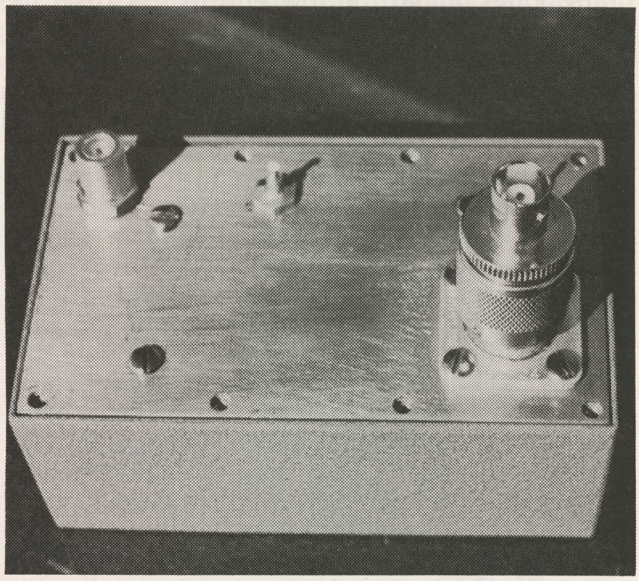
One option for cable powering of the masthead unit is shown in **diagram ten.** The objectives are as follows:

1) An operating voltage must be supplied to the RF and IF amplifiers. Within these stages zener regulation of the base is a necessity while the collector can run at a higher voltage (up to 14 volts or so).
2) The LO must have an operating voltage, and a fine tuning voltage to bring it back on frequency it if is either the Avantek unit or a free-running oscillator. Chances are, with a bi-polar free running oscillator, a pot on the B+ line will tweek it enough **within** the 9-14 volt or so range that you could tweek the **whole** of the B+ line and not appreciably affect the performance of the RF and IF stages from the same line. Use of the Avantek VTO-8090 transistor oscillator requires a regulated positive DC operating voltage of around 14-15 volts; but a 'tuning

DIAGRAM ELEVEN



LOW COST CORNER REFLECTOR ANTENNA IS CONSTRUCTED FROM PIECE FLAT ALUMINUM (15 1/2" x 3 1/2" BEFORE SHAPING) AND FED WITH DIPOLE AND 1/2 WAVE MATCHING SECTION (2 3/4") CONSTRUCTED FROM #8 OR 10 COPPER WIRE. GAIN ABOUT 12 1/2 dB OVER DIPOLE.



CREATIVE MDS CONVERTER constructed around Avantek voltage tuned LO source has low noise front end, double balanced mixer and ATF 414 i.f. amplifier (see text).

voltage' someplace between 2 and 48 volts.

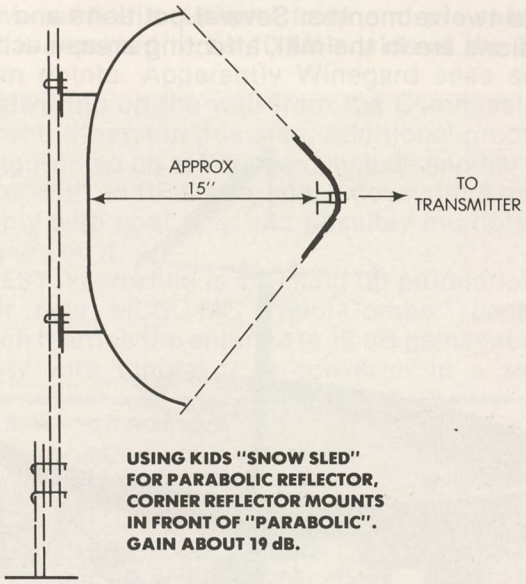
3) The actual portion of the VCO (VTO-8090) you really want is probably going to be within a narrow range however. For example, in another version of the same Avantek oscillator family (the VTO-**8150** which tunes **directly** 1500 to 2500 MHz, thereby allow you to feed a mixer on-frequency rather than at half frequency) CATJ found that if the tuning voltage applied was 21 volts our IF output was channel 2 while a tuning voltage of 28 volts got us all the way up to channel 7. This suggests that the actual range of the tuning voltage to keep the LO "on channel" will be very low; in the tenths of a volt range in most situations. This also says the tuning voltage supply line needs to be stable or you'll have LO drift as a function of varying supply voltage, not component changes with temperature.

The Antenna

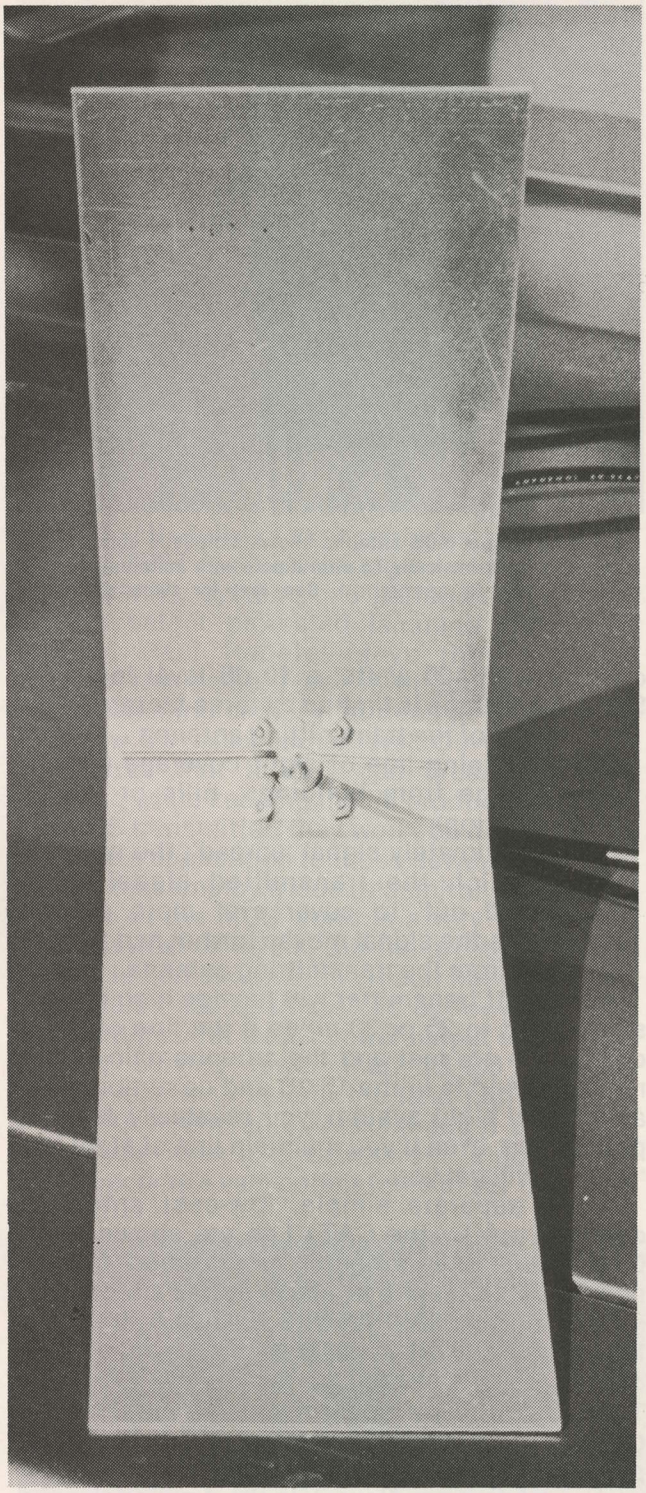
As should be obvious by now, the antenna is simply part of the system 'dB equation'. Throughout the package you've got to realize a certain amount of total gain. Even with a relatively low gain antenna (13 dB) and a moderage gain converter (26 dB) you can realize 0 dBmV levels with very low input signals (−40 dBmV). RF gain and IF gain is not the total answer to high quality (i.e. 40 dB **signal to noise ratio)** pictures since we have a noise threshold here in the −55 to −57 dBmV region in the best cases (the best case being a low noise figure active electronics portion).

Obviously to realize a good quality signal requires a fair amount of antenna signal voltage delivered to the first stage of the converter. The antenna is the practical answer.

DIAGRAM TWELVE



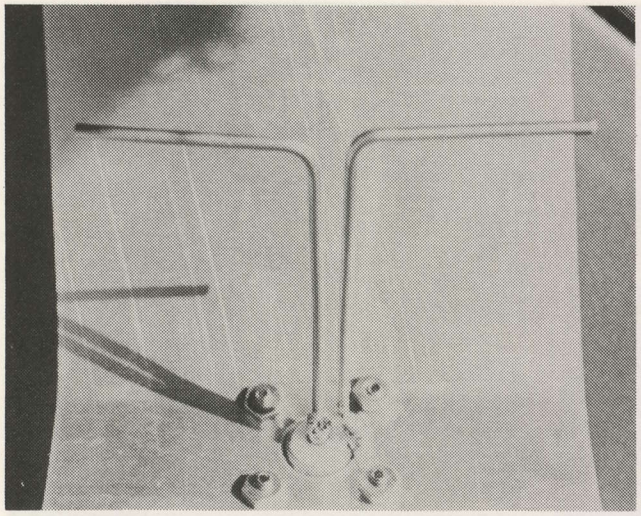
USING KIDS "SNOW SLED" FOR PARABOLIC REFLECTOR, CORNER REFLECTOR MOUNTS IN FRONT OF "PARABOLIC". GAIN ABOUT 19 dB.



LOW COST corner reflector antenna has around 15 dB of gain at 2.15 GHz. Antenna is constructed from commonly available sheet aluminum, utilizes simple dipole feed (see text.)

In this system as with any receiving system antenna gain is a function of antenna capture area. Which is another way of saying 'bigger' (if well designed) is better. Although bigger, especially in home installations, is not always practical since big-size means bigger cost dollars for both the antenna and the structure to hold it.

Most MDS transmitters operate with 10 watts power although a few have FCC permission to



FEED on low cost MDS antenna shows simplistic construction feed antenna is basically 75 ohm dipole with matching section (parallel lines to connector). **See text for dimensions and construction.**

operate with 100 watts; a **10 dB** level **increase.** System coverage is limited by three factors:

1) Height of the transmitting antenna
2) Maintaining line of sight coverage (i.e. no blockage from buildings, hills or dense vegetation)
3) And ultimately signal 'spread'; the process by which the transmitted signal must 'spread out' to cover ever more ground area as the signal moves further and further away from the transmitting antenna.

A ten watt transmitter will provide high quality signals out to 25 or 30 miles if the line of sight conditions are met and the antenna gain at the receiving end is in the 15 dB and up region. Like any line of sight system, you **eventually** reach a point where even if you maintain line of sight the 'spread' will get you.

Three separate simple, low-cost antennas checked out by the CATJ Lab are shown here. One is a corner reflector constructed from a sheet of aluminum that starts out as a rectangle measuring 15-1/2 inches by 3-1/2 inches. It is configured as shown in **diagram eleven.** A type N connector is mounted in the middle of the 1-1/2" 'straight-back' section and two pieces of #8 or 10 copper wire are made into a dipole/impedance matching section (see right hand portion of diagram eleven). In the drawing the top "half" of the dipole is attached (soldered) to the center pin on the chassis mount N connector while the equal bottom half is attached with a metal screw or machine bolt immediately adjacent to the barrel of the connector. Gain is about 12-1/2 dB over a dipole and the antenna is simple to construct (see photos here).

In **diagram twelve** we have taken the same corner reflector antenna and after a stop at J.C. Penney's where we picked up a **26"** "Snow Sled" which looks strangely like a parabolic of sorts we constructed a corner reflector fed parabolic for the service. Gain on this measured around 19 dB over a dipole and including the Snow Sled the total cost was under $10.

In **diagram thirteen** we have the ever-popular Helix or 'helical' antenna adopted to the MDS service. A helical antenna is inherently broadband (see **CATJ** for **October 1975** page 10 and **March 1976** page 9) and quite forgiving of most construction errors. The 17 turn helix shown uses a 1-3/4 inch piece of PVC pipe as a support mechanism for the #8-10 copper wire which the turns are wound with. A type N connector gets one end of the copper wire (solder to center pin) while the opposite end of the wire ends up being stuck into an appropriate diameter (tight fit) hole on the front of the PVC pipe. The square reflector measures 7 by 7 inches and aluminum is suitable. Wind the copper wire tight and if you want to protect the array from weathering shellac the PVC plus wire wrap several times after completing construction.

A word here about moisture. Keep in mind that we are into the 'microwave region'; even if the equipment still looks like circuits you are vaguely familiar with. Moisture is a deadly enemy at these frequencies and you will need to keep it out of antenna fittings, coaxial fittings and most of all any electronics you hang outside. One simple solution is to place everything into a good quality metal container and then button up the seams, fittings (after cables are in place) and other air inlets/outlets with a bathtub caulking compound or silicon cement. Another solution is to wrap the electronics in a plastic sack, tape it up and hope that moisture doesn't condense inside during the spring and summer. In that regard, a small vent or 'drip' hole on the bottom of the container spotted where moisture will gravitate to a low spot before filling up the container will help.

Changes Coming

It would appear that nothing 'big' is in the wind at the FCC for MDS; at least not within the next six to twelve months. Several petitions and discussions are in the mill, affecting areas such as

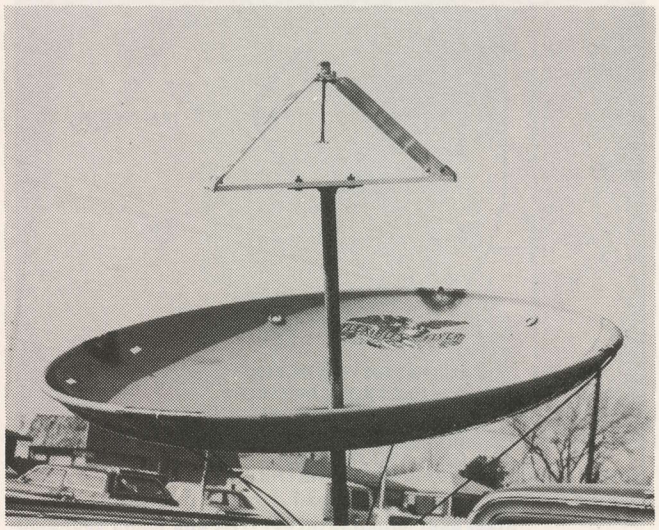
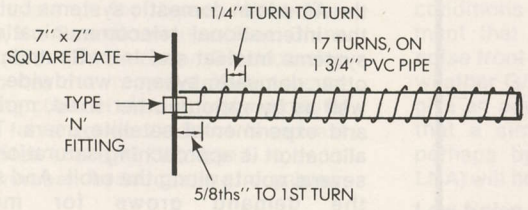
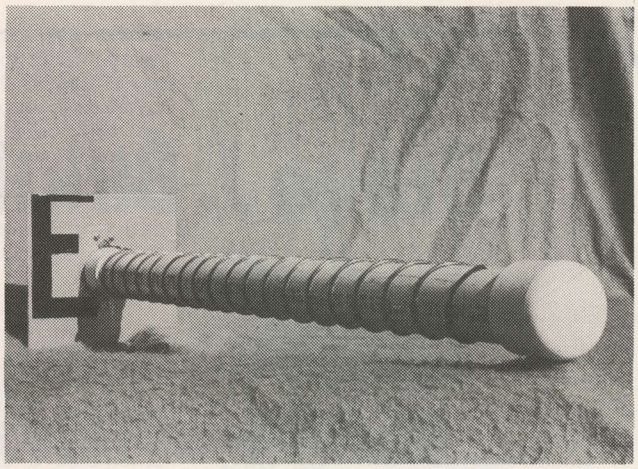


DIAGRAM THIRTEEN



17 TURN HELIX ANTENNA IS WOUND ON 1 3/4" OD PVC PIPE. GAIN IS APPROXIMATELY 15 1/2 dB. MATCH IS BROAD BAND.



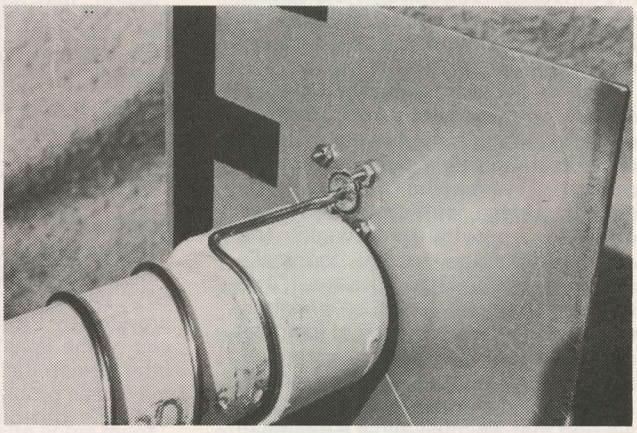
maximum permissible power (some want to increase the 100 watt level), converter design characteristics (the FCC may be thinking about requiring greater front-end selectivity) and a few other minor areas.

Addressability is the big technical hurdle ahead. Some firms working on this are hopeful of public display of addressable packages as early as late May; at the NCTA annual bash.

Aside from this area, there are new products from existing suppliers and at least one new 'serious' supplier in the field; **Winegard Industries.** The Burlington, Iowa firm will shortly be announcing a new crystal controlled MDS converter and a pair of 'Paraceptor' (parabolic-like) antennas for the field. The antennas are rated at 18 dBi ($20-25 range) and 21.5 dBi ($30-35 range) with field-rotation to either of the two polarizations. Both are 50 ohm feed with an attached 'pigtail' of coaxial line about 24 inches long. The new Winegard Industries converter is a 14 dB gain package with a 'selected' diode mixer and a noise figure around 9 dB. All of the electronics (other than the power supply which duplexes 12 volts DC to the converter masthead) is at the antenna. Price range on the converter is around $100 ("in quantity"). The model MDC-(IF) converter has a 'unique' front end pre-selector that is reported to be 10 MHz wide at the 3 dB down points. Apparently Winegard sees some handwriting on the wall from the Commission's current interest in this area. Additional products being worked on at Winegard include another converter with an RF stage, and, a downstairs power supply with post amp and possibly multiple (IF) outputs on it.

TEST meanwhile is cranking up production on their new MDSC-MC "Mini-Combo" package which marries the antenna (a 12 dB gain resonant cavity with dipole) to a converter in a single housing. Injection molding techniques will be utilized with delivery expected after the first day of May. TEST is also working on a next generation jamming system; one patterned after their current patent protected jamming carrier approach. Paul Rebeles says they hope to achieve the same type of effective jamming with a jamming carrier that rides as much as **16 dB below the visual carrier level.** Obviously TEST recognizes that if they can create effective jamming while keeping the IM products in line at the MDS transmitter, they won't be limited in the package's application to those newer MDS transmitters that employ triode transmitting tubes.

All in all the MDS world is a very busy place these days at all levels. But the greatest wonder of it all is perhaps that this much busy-ness and controversy has been created by fewer than 40 transmitters with a **total power output** of perhaps 2.5 kW serving fewer than 25,000 separate receive locations nationwide (and half of those are in the Anchorage, Alaska area). If MDS ever figures out what it is, or where it is going, this could become a very potent force in our time.



Bird Delivered Newspaper?

RCA should have filed, before you read this, an application to provide what it terms 'end-to-end satellite service', on behalf of client UPI. The new service will require a (SCPC) 15 kHz channel on SATCOM, and will deliver to approximately 600 UPI radio stations both audio news feeds ("actualities") **as well as** UPI **teletype news services.**

This is the first time that RCA American Communications will act as both a common carrier and as a supplier of all of the hardware required at all of the sites involved. RCA plans to file applications to provide approximately 600 ten foot diameter dishes, which would be part of a receive only package that will include an LNA and an (audio only) receiver. The plan is part of a program at UPI to convert all of its services from landlines to satellite.

Steve J. Birkill On Experimental Earth Terminals

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Orbital Congestion

Along the circle of 26,000 miles radius that forms the geostationary orbit there is space only for a limited number of satellites of similar characteristics serving any particular area. If that area be defined as say the whole of the contiguous United States, and antenna elevations (at the earth terminals) **down to 5 degrees above horizontal** are allowed, this confines the satellite position to an arc stretching from about 56 degrees to 138 degrees west of the Greenwich meridian. **If coverage is to include** Puerto Rico, Hawaii and Alaska, this narrows to **122 to 138 degrees west** (the northerly latitudes of Alaska are the most demanding of satellite longitude if low elevation angles are to be avoided). For this reason only those satellites towards the western end of the 'North American Domestic Satellites' arc of orbit can provide full USA coverage including the northern regions of Alaska.

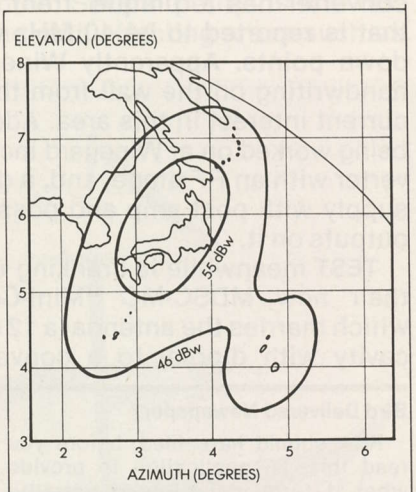
Now to avoid interference between downlink transmissions from satellites operating in the same frequency range and directing their beams toward the same or overlapping areas on the Earth's surface, sufficient separation must be provided between the satellites for the receive terminal's antenna to discriminate one transmission from another. Considering the worst case of identical carrier frequencies and polarizations, and that for FM TV a protection ratio of 30 dB (1000 times power) is **desirable,** we find that we must allow a minimum of about 4 degrees spacing along the orbit, for satellites operating in the 4 GHz band. This means we could fit only five satellites into the (optimum) belt serving the **entire** USA. For maximum capacity, each of these will employ the complete 500 MHz spectrum, in some cases (as with the RCA Satcom and AT&T Comstar birds) using it twice, by interleaving carrier frequencies of the orthogonal polarization. For reasons of off-axis polarization purity and satellite attitude control stability it is not practical at present to re-use frequencies by polarization separation except **within** the one satellite. The only way to fit more channels into the existing frequencies within that belt (considering standard channel widths and excluding half-transponder and 'two-channels-into-one' techniques) is to **divide up the coverage area** among two or more satellites—**spot beams** serving widely spaced geographical regions could give the necessary 30 dB separation. This technique is in fact used on eight of the transponder frequencies on the Intelsat IVA birds, but would be less suitable for a cable application, where it is usually desirable to get the same program into as many locations as possible. Here the exception might be time-zone coverage, but the size of the zones in relation to the 'next-but-one' zone spacing makes for a tight specification on the satellite antennas to achieve that 30 dB or so, in the case of nominally co-sited birds.

We must also consider uplink constraints in the design of any frequency re-use system. The uplink band is also only 500 MHz wide (at 6 GHz) and discrimination **must also be provided** by the antenna gains at **each end** of the uplink path to ensure non-interference between channels. This may mean problems in the siting of the uplink stations, involving long terrestrial 'back-haul' circuits to separate stations directing the same frequencies to the same area of sky.

Ku-Band

Whatever techniques are employed to re-use the frequencies, there comes a point (it's close) when at the present growth rate the orbit is just becoming too crowded and there's nowhere for new channels to go, within the existing frequency band. **C-band** (6 GHz up, 4 GHz down) is heavily used not only by the American domestic systems but by the international telecommunications systems Intelsat and Inter-Sputnik, by other domestic sysems worldwide, as well as by various other fixed, mobile and experimental satellite users. The allocation is approaching saturation at several points along the orbit. And still the demand grows for more international channels, more domestic telecommunication and TV-distribution, and in Japan, Europe and the Middle-East plans are well under way for direct-to-home TV broadcasting by satellite. **The only way to fit in these extra services is to move to higher frequencies** where not only is there unexploited spectrum space but also the advantage that a narrower beam is obtained for a given antenna size, thereby enabling closer spacing between satellites. The next higher frequency band available for commercial satellite service is **Ku-Band,** with uplinks around 14 GHz and downlinks in the 11/12 GHz region.

As allocated at the World Administrative Radio Conference in Geneva, **1971,** downlinks for the fixed satellite service **may** use the frequencies **10.95-11.20 GHz, 11.45-11.70** and **12.50-12.75** (11.45-12.20 GHz in the Americas), and for satellite **broadcasting,** 11.7 to 12.2 GHz (or to 12.5, depending where you are). Up to the present, these frequencies have been used by satellites only on an **experimental** basis, but this year will see the start of an operational international service when the first of the new generation Intelsat V birds takes up its station over the Atlantic, carrying transponders in both C- and Ku-bands. The USSR's Intersputnik organisation has its parallel system planned, using Loutch satellites, and the list of Domestic and Regional schemes is impressive, including **TDRSS**/advanced Westar and **SBS** in the USA, Anik **B** and **C** in Canada, the



FOOTPRINT OF JAPAN'S BSE (CO-ORDINATES RELATIVE TO SATELLITE)

European Communications Satellite, **Nordsat** for Scandinavia, **Zohreh** for Iran, plus direct and community broadcast systems for Japan, West Germany, the Scandinavian nations, China and India. The European Broadcasting Union has drawn up detailed plans including channel allocations and orbital slots for a series of direct broadcast satellites in the 12 GHz band, to serve its member broadcasting organisations.

Comparison of characteristics

The higher frequencies of Ku-band inevitably mean that certain parameters of the earth station are more critical if similar performance to C-band is to be obtained. The wavelength of **2.5cm** instead of 7.5cm requires an increase of a factor of three in the surface accuracy of the antenna's reflector, if its maximum gain is to be realised. Feed positioning is similarly more demanding than at the lower frequency—a half-inch error can easily drop the gain by 6 dB. Of course, the antenna aperture need be only one-third of the 4 GHz value, to achieve the same gain. But there are several factors making it desirable to have more gain available than in the 4 GHz case.

Path Loss

Free-space loss at 12 GHz runs about **10 dB higher** than the 4 GHz figure—206 dB is typical. To this must be added the additional atmospheric attenuation experienced at 12 GHz. The oxygen and water vapour present in the air along the signal path both give increased absorption with rising frequency—**water vapour** exhibits a broad resonance peak centered on **22 GHz** approximately, and the 12 GHz band is on the steeply-rising LF skirt of this curve. **Atmospheric oxygen** has a first attenuation peak at some **60 GHz,** and its effect at 12 GHz is small. Both these factors assume greater significance when working at low elevation angles, the distance traversed by the signals through the atmosphere being greater. The other important source of attenuation is **rainfall** in the locality of the earth stations—various models have been proposed to quantify statistically its effect—in tropical climates it **could add** an extra 20 dB to the path loss for short periods. At 12 GHz, in temperate climatic regions, a figure of 6 dB in excess of the clear air value, for 0.1% of the worst month, is a reasonable assumption. Clear air atmospheric loss at 15° elevation will be about 0.6 dB. **So our total downlink path loss amounts to something in the 212-213 dB region under assumed worst-case atmospheric conditions.**

Atmospheric Noise

In addition to attenuating the signals, the water vapour, oxygen and rain present all act as **additional noise sources,** causing degradation of the effective antenna noise temperature and hence the G/T. At 22 GHz, the water vapour absorption line represents a noise temperature in the 100K region. **At 12 GHz,** the equivalent 0.1% worst month figure for total atmospheric noise is about **1500K.** These conditions limit the degree of improvement that can be obtained with low noise front-ends—increasing the clear-weather G/T with a larger antenna will give an advantage in adverse weather that a similar increase (contributed perhaps by an expensive parametric LNA) will not.

Low-Noise Amplification

The current state-of-the-art in commercially-produced GaAsFET LNA's at 4GHz gives an 85-100K noise temperature. In 12 GHz technology, the equivalent achievable figure is in the 250-300K region. Going to a parametric amplifier will result in perhaps 230K uncooled, 40K cooled.

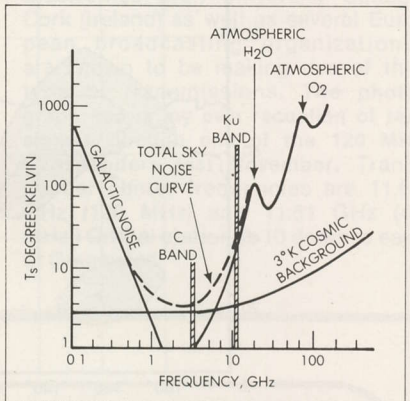
Planned satellite systems in Ku-Band

The use of the frequencies around 11-12 GHz for space-to-earth paths divides naturally into two types of system: the telephone, data and other telecommunications traffic (including common-carrier, leased, and occasional TV program relay) as presently carried on the 4GHz international, regional and domestic satellites; and the new era of direct broadcasting satellites, such as have only been made possible on a large scale by the move to the 12 GHz band.

Telecommunications etc.

The Intelsat-V series of satellites, the first flight of which is due this year, will be the first to use commercially **both forms** of frequency re-use; **spatially,** by the use of **independent spot beams,** and by employing orthogonal linear polarizations. The **4 GHz** transponders will continue to use **circular** polarizations, but will again re-use the frequencies by **opposite senses of circular polarization,** together with hemispheric and zone-coverage beams. By these means **each frequency will be used four times.** Transponder bandwidths will generally be well in excess of the 36 MHz we have come to expect at 4 GHz. To allow high bit-rate digital PCM and data transmission **72 MHz will become a common channel width,** and the heavy route Ku-Band traffic will pass through **two transponders each of 240 MHz bandwidth.** To handle these bandwidths with sufficient margin against propagation fading is clearly a tough requirement of the 11/12 GHz downlink; spot beam EIRP levels will be in the 44 dBw region and earth station G/Ts in excess of 40dB/K in this band. Even so, space diversity may have to be used at some locations such that the service can be transferred to a site some miles away to avoid the effects of a local rainstorm.

Of the **domestic** commercial telecommunications satellites in the 11/12 GHz band I have little information to hand at present, but EIRP levels are expected to be the same as, or a few dB higher than, Intelsat V, transponder bandwidths within the range 36 to 72



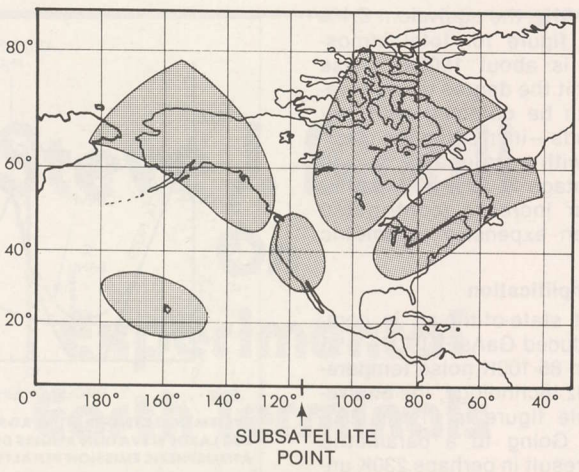
SYSTEM NOISE TEMPERATURE AGAINST FREQUENCY FOR LARGE ELEVATION ANGLES DEMONSTRATES ATMOSPHERIC EMISSION PENALTY ABOVE 10 GHz.

MHz, and the margin against fading may be rather less generous than that of the global systems. **This will mean a rooftop antenna** of typically **2 meters aperture,** located if necessary within a city center area, will be able to work through these satellites.

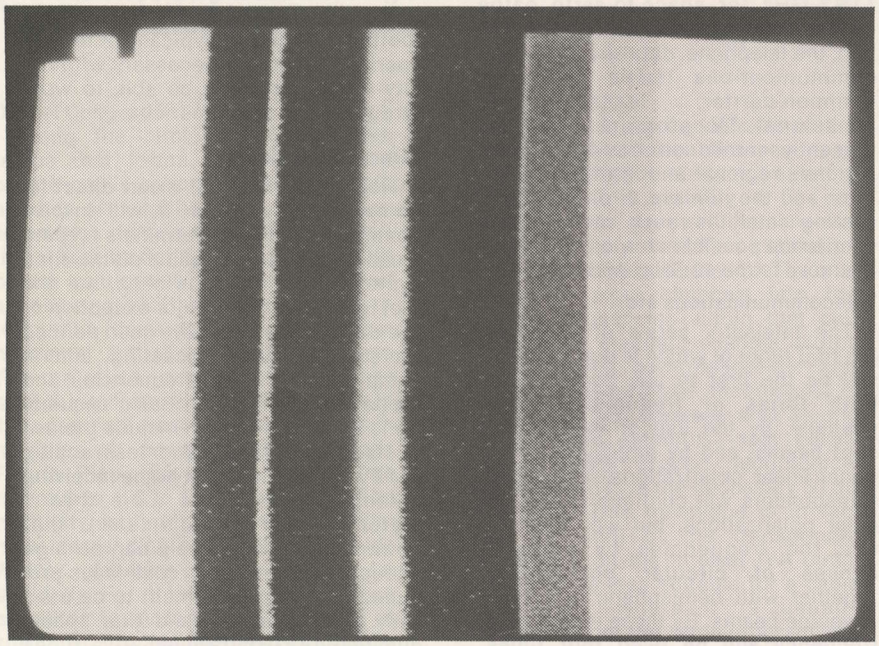
Direct Broadcasting

How much this will mean **direct-to-home** and how much it will involve **community receiving terminals** feeding small transmitters or cable distribution systems remains to be seen, but the fact is that (with the major exception of the USA) parameters have been defined for satellite TV broadcasting, and in some cases channel frequencies and orbital slots allocated. Basic assumptions for such a system include the use of **standard 36 MHz BW** (or less) analog FM TV modulation; that **home receiving antennas** must be no more than **1 meter in aperture** (diameter); that power flux density levels can be high enough to permit low cost mass-produced receiving equipment to be used with such antennas; and that space-qualified 12 GHz traveling-wave tubes are developed at the 100 to 500W output power level.

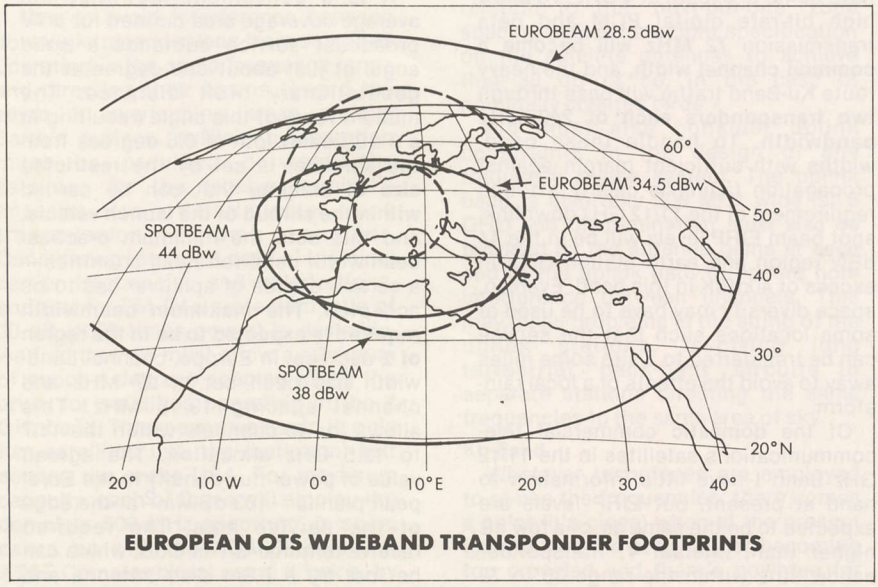
It is a convenient fact that the average coverage area defined for a TV broadcast service subtends a solid angle of just about one degree at the geostationary orbit distance. The minium value of this angle (resulting in a 3 dB beamwidth of 0.6 degrees from the satellite) is set by the **restricted size of antenna** that can be carried **within the shroud of the launch vehicle,** and this sets the minimum practical beamwidth used for small countries—a certain degree of spillover has to be accepted. **The maximum beamwidth required is expected to be in the region of 2 degrees.** In Europe, channel bandwidth has been set at 27 MHz and channel spacing 19.18 MHz. This allows for 40 channels within the 11.7 to 12.5 GHz allocation. The agreed value of power flux density in the European plan is -103 dBw/m^2 at the edge of the service area. The required receive terminal G/T is 6 dB, which can be met by a 0.9m dish antenna and



CANADIAN CTS: TYPICAL FOOTPRINTS FOR 56 dBw EIRP



EUROPEAN OTS 11.64 GHz transponder received at Sheffield, England during November, 1978 early tests of OTS.



EUROPEAN OTS WIDEBAND TRANSPONDER FOOTPRINTS

receiver noise figure of 8 dB, readily achieved with diode mixers. (Next month's column will look a little deeper into receiving techniques for these frequencies). Satellite EIRP values are in the 60 to 70 dBw range, requiring high power amplifier outputs of the order of 200W, dependent on beam size.

Pre-operational Ku-band systems

A number of experimental or test satellites are currently involved in assessing the characteristics of propagation, equipment and techniques for 11/12 GHz, prior to the full operational use of the band.

CTS

The Communications Technology Satellite, also known as the Cooperative Applications Satellite C_1 or 'Hermes', is a joint experimental broadcast-scale satellite of NASA and the Canadian Department of Communications. It carries several advanced technology experiments, the most significant being the 200W 12 GHz TWT (traveling wave tube) high power amplifier. The downlink consists of two 85 MHz-wide channels, one of 60 dBw EIRP centered on 12.0805 GHz and one of 50 dBw on 11.8855 GHz, via two independently steerable antennas giving a beam of 2.5 degrees width, of circular cross-section. CTS is stationed at 116 degrees west longitude, and is now at **the end of its nominal experimental life.** TV tests with CTS have included transmissions to community-type terminals of 2m diameter, and trials of direct-to-home receiving equipment, including notably a **0.6 meter terminal** operated **inside** a building, signals passing through a closed window. This test yielded a weighted video S/N ratio of 45.1 dB, with an estimated 2 dB transmission loss due to the window.

BSE

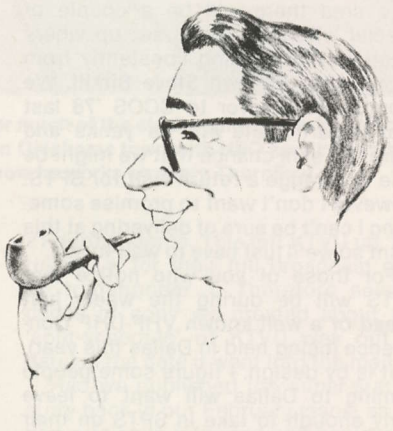
The 'Medium-Scale Broadcasting Satellite for Experimental Purpose' was built by the US General Electric Company under contract to Tokyo Shibaura Electric Company for the Japanese space agency NASDA. It provides two TV channels of 58.5 dBw each, centered on 11.975 and 12.075 GHz, into a specially configured footprint to cover the Japanese islands. BSE's objectives include demonstration of direct-to-home TV transmission, particularly into those parts of Japan shielded by mountains from terrestrial coverage; also development of low cost, high performance home receiving terminals. Orbital station is 110 degrees east.

OTS

Europe's Orbital Test Satellite was conceived as the pilot scheme for the European Communications Satellite project. Built by the MESH consortium for the European Space Agency, it carries four wideband transponders, two each of 40 and 120 MHz bandwidth, employing frequency re-use by orthogonal linear polarizations. The 120 MHz channels feed a spotbeam

antenna of 2.5 degree beamwidth, beam center EIRP being 44.6 dBw. The 40 MHz channels, of nominally equal transponder power (20 watts), operate through a lower gain elliptical 'Eurobeam' antenna covering the whole of Europe and **parts of** Northern Africa and the Middle East. EIRP at Eurobeam center is 35.1 dBw. The OTS mission objectives include deriving propagation data for Ku-band, particularly with regard to atmospheric depolarization (which reduces the interference margin between the co-channel transponders) and precipitation attenuation. The 40 MHz channels can carry standard FM TV, the 120 MHz channels wide deviation ('Eurovision Standard') FM TV or digital TV, or all channels can carry digital telecommunications or data. By putting **standard** (27 MHz bandwidth) FM TV through the spotbeam transponders, ESA can test small (2.4 meter) receive-only terminals. The UK's Independent Broadcasting Authority, Ferranti Electronics Ltd., University College Cork (Ireland) as well as several European broadcasting organizations, are known to be making use of this type of transmissions. **The photograph shows my own reception of test signals through one of the 120 MHz transponders last November.** Transponder center frequencies are 11.64 GHz (120 MHz) and 11.51 GHz (40 MHz.) Orbital station is 10 degrees east of Greenwich.

Coop's cable column



bob cooper editor in chief CATJ

A Satellite Seminar

CATJ has added several thousand **new** subscribers recently. A good percentage come from the cable world but a much larger percentage comes from the **'private sector';** people who have an interest in satellite TV service.

Shortly after this new rapid growth began we began we to hear from the private sector bunch; asking us if they could attend this year's CCOS (79). At first I didn't see any harm in it, if they were willing to pay a registration fee like anyone else. In subsequent months I changed my mind, primarily because I got the distinct uneasy feeling that we might end up with more 'private-sector-satellite' people in attendance than cable people. **CCOS is,** after all, **'our' annual show.**

Still, there's no effective way to police attendance at CCOS '79 at Lake Geneva (Wisconsin) this year so some other plan had to be devised to make it plain that CCOS '79 was probably not their best choice.

So here is what I plan to do. **We will put on,** separate and distinct from CCOS '79 and having absolutely nothing to do with CATA, **a "Satellite Private Terminal Seminar"** (or SPTS for short). Tenatively I plan to do this for three days, here in Oklahoma City, **August 14-15-16.** That's a Tuesday, Wednesday and Thursday. I've arranged for a local Junior College district to allow us to use their facility; we will have one large auditorium that will seat up to 500 people and a bunch of "class rooms" where up to 70 people can gather. The school will open its cafeteria for us for our meals, and motels are within a short driving distance. So much for the logistics.

Now, what would such a seminar "teach"?

Well, **Oliver Swan** has volunteered to bring back a truck load of hardware and to build (on the site) one of his new **spherical TVRO antennas.** That's 20 foot by 20 foot of reflector surface. Oliver will leave the antenna behind; we will donate it to the JC district. **Jim Vines** at Paraframe will bring down one of his 16 foot homebrew **stressed-bolics** and teach people how to build the same antenna at home. We'll have the usual assortment of large and small dishes; including a ten foot job on a trailer that it's owner pulls around to demonstrate TVRO reception.

H. Paul Shuch (Microcomm in San Jose, California) has offered to be on hand to teach receiver and LNA design techniques. Since Paul normally gets $600 plus transportation costs for two hours of lecture time we think this is a coup for us. Another chap is interested in coming up and showing us how to convert a **Western Electric TD-2** 4 GHz microwave receiver to TVRO use. The TD-2 pieces are available on the surplus market for peanuts (typically under $25) and while I can see several hundred more dollars in making it fly, it presents another opportunity to get a terminal operating for (relatively speaking) peanuts. I will also round up some of the smarter TVRO receiver design engineers from the commercial houses (SCI, Microwave Associates and others) to be on hand to teach their approach to designing a TVRO receiver.

In the **LNA** area there's a fellow in the Dallas area who has worked out a very fine 250 degree K unit using bipolar (i.e. quite cheap) transistors and I think I can talk him into showing us how it is done. We'll also bring in a couple of the commercial LNA people to explain how they design their units.

And since there are some who need questions answered on the legal aspects of private terminals, we'll see that there are people on hand to answer your questions. I toyed with the idea of bringing out some knowledgeable chap like **Bill Lombardi** of the FCC's Common Carrier Bureau to head up this aspect of the seminar. Bill's an OK guy who understands where the private terminal people are coming from; but having an FCC person on hand might 'inhibit' some of the attendees so I'm still thinking this one over.

Now with all of the gig-a-hertz technology going on in one area it seems a shame to bottle it up just in the 4 GHz area. So we'll have two separate 'Synposiums' within the Seminar proper; one will deal with **10 GHz** (video/Gunnplexer) **microwave systems,** and, the second will deal with **2.15 GHz** (MDS) converter technology. As this issue of CATJ details, there is a considerable amount of very clever 'original design work' going on in the **MDS** area. Appropriate people will show how to build antennas, converters and all of the hardware you need to be in business in either of these two frequency ranges. In fact we will hold a 2.15 GHz "Antenna Measuring Contest" during the Seminar and encourage people who have built their own MDS receive antennas to bring them along. We'll have some definite rules on this later on, but basically you'll have to hold the antenna above your head (that limits the size and weight) and compete for

maximum gain and pattern against all other entrants. We'll have prizes.

I said this will be a three day affair. Actually it will extend into **four days;** Friday the 17th will be a kit construction day and a day to spend time with people on the program on an informal basis. Staying over on Friday is of course optional.

I plan to videotape the whole seminar and offer the tapes for a reasonable fee; of course the tapes will cost more than the attendance fee since the 1/2 inch blanks are still so expensive. Obviously the best thing to do is to be on hand, but if you can't be. . .we'll have the videotape option. In the videotape area there will be a couple of special 'viewing rooms' set up where tapes will be running constantly from people like our own **Steve Birkill.** We brought Steve over to CCOS '78 last year to participate with us 'yanks' and there is a slim chance that we might be able to arrange a return visit for SPTS. However I don't want to promise something I can't be sure of delivering at this point so we'll just have to wait to see.

For those of you who notice that SPTS will be during the week, **just ahead of** a well known VHF-UHF Conference (being held in Dallas this year), that is by design. I figure some people coming to Dallas will want to leave early enough to take in SPTS on their way to Big D. If you are traveling across the country, you might as well make the most of it.

A high percentage of the private terminal people I've heard from are doing it on the **buddy route;** that is, two or more people are getting together to build the first terminal up. In recognition of this fact, we've created an interesting set of registration fees for SPTS. The fees are high by some standards, but this is going to be an expensive 'show' to put on. For the first person registering on a single registration form, the fee will be $125. For the second person on the same form, $110. And for the third (through ten maximum) on the same form—**$100 each.** In other words, we want to encourage people to come in groups.

If you have your own video tape recorder, you can bring it along (with a supply of blank tapes) and provided we know you are coming with the machine we'll set you into the 'daisy chain' string and record for you a selection of the sessions you decide you want on tape. We'll also make it possible for you to make dubs of the 'viewing room' tapes from people like Birkill. Obviously there is no way we can handle several hundred tape recorders at once so we will offer this **"no-charge plug-in"** service up to the point where one man can start and stop the assembled videotape machines on premises.

Sound like a pretty neat affair? You should have been around when I was outlining SPTS to a couple of guys from Colorado. One suggested that we have a seminar session of **"Satellite Jamming"** which **he** wanted to call "How To Take Over Control Of A Satellite". His partner even suggested that we could set up an uplink and demonstrate how it is done! They were both serious. . .and with the recent clandestine garbage that tore up transponder 1 on SATCOM I it appears to me there is at least one 'scmebody' out there that could tell us how it is done. Be that as it may. . .I don't think we want to get into that. . .this year. On the other hand it sure would attract a crowd.

I fully expect this first-year SPTS to be a sell out. That means that we have to say straight forward and out front . . .when the facilities are full, **that's all of the people we can handle.** There's a registration card application on pages 56A and 56B here this month. And remember, the more people that register together the lower the price gets per person. Where else can you learn so much, see so much, and have such a good time for so few bucks? And take home some exciting new technology that you can immediately put to work for you!

Breakthrough For Private?

I have always prided myself on being a pretty good reader of 'Indian Signs'. However, as an experienced 'scout' I am seldom mislead by a **single** sign in a forest of trees so I usually don't get caught with my anticipations up prematurely.

I see numerous 'signs' out there in the private terminal area. Private, for the uninformed, is the classy word that says 'cheap TVRO terminals'. Let's just call them cheap for a few minutes.

Many hundreds of folks have ponied up 15 or 20 thousand dollars for a backyard terminal and more probably will. If the public at large ever figures out where to go and order the darn things, we are apt to see a landoffice business in this area for a couple of years; even at the not-so-cheap 15 to 20K price range.

Below (well below) **that** price-interest group is a much bigger group that would love to have a terminal but can't see second-mortgaging their home just to watch nasty flicks on the tube. My telephone calls and correspondence says there is one 'threshold of pain' around $1,000 and another larger one at $5,000.

Several capable suppliers, aware that the CATV boom is leveling out and ready to head down in the TVRO area, have been scratching around looking for ways to keep their gross sales up. Outside of the TVRO field, at least two very well known household-word consumer electronic firms have been attacking the 'private' (as in cheap) terminal from different directions. Which says off-shore production.

So here's my crystal ball, based upon the Indian Signs out there. I'll let you hold me accountable along about December since these 'forecasts' are based upon the balance of 1979:

1) **Look for at least one major commercial TVRO supplier** to announce a $15,000 designed-for-consumers terminal with a 12 foot antenna (polar mounted), high quality (120 degrees K) LNA and an RF output (to interface to the TV sets) before the summer is over.
   That's not revolutionary. What will be is their marketing program, aimed at creating a national installing distributor network and direct consumer marketing techniques.
2) **Look for another major TVRO sup-**

plier to announce a four meter fiberglass antenna shortly and don't be surprised if a tuneable receiver at a new low price follows.

3) **Look for several new** 'tuneable' receivers to pop loose, none from major manufacturers, all probably hampered by start-up problems; in the $2,200 to $3,000 range. We see these being 'pitched' to the non-CATV marketplace.
4) **Finally,** look for some creative soul to show us how to take around $500 in surplus parts and a few evening's time to put together a private terminal that produces **pictures** on a ten foot dish **with no LNA;** although you probably won't get raves from your neighbors over the picture quality if you employ this system.

OU STUDENT Mike Coursey is responsible for much of the studio camera work seen on SATELLITE MAGAZINE. His family lives in an Oklahoma town with HBO service and he has a proud 'Mom and Pop' watching the show he works on every Thursday!

What's In A Name?

In our March magazine, page 27 within the article detailing the 'Second Season' of Satellite Magazine we commited one of those no-no errors. It would be funny if it wasn't so pathetic.

The photo on page 27 (top right) identifies an OU student manning a camera during the taping of Satellite Magazine as Steve Miller. The proper identification appears with the photo which re-appears here. Now lot's of magazines make mistakes like this; an occurence promulgated by the non-familiarity of the magazine people with the subjects being shown. In this case the error was inexcuseable because I work with **Mike Coursey** several times each month during the production of Satellite Magazine and I know his name is Mike not Steve. What is particularily strange about the Steve Miller name mis-use is that when we first began the program way back in November a chap named Steve Miller **was scheduled** to be on the OU student crew. We even had the opening and closing credits made up to include his name. But Steve Miller, whoever he is, never did show up. Not even once. Along about the third show we deleted his name from the credit listing (which is only fair).

So Steve Miller whoever you are and wherever you are. . .lot's of luck. With your flair for gaining credits by not doing anything at all you certainly have a leg up on the rest of us who have to work for a living!

Deadlines

Magazine deadlines are inflexible. A case in point. The March issue report on the 'battle of the super stations' was written early in February and just before we shipped the magazine 'flats' off to the printer we checked with each of the super station representatives to see if any major changes were in the wind. One, Kip Farmer at SCS/SSS said **"Yes, we have to do something with transponder 21 and what we decide to do with it will impact on transponder 1 use".** Transponder 1 is the home of KTVU. Kip couldn't tell us exactly what would be done and suggested we could find out for certain-sure on February 15th. Only the printer got the magazine 'flats' on the 14th.

As you undoubtedly know by now (we talked about it on **SATELLITE MAGAZINE** on the 8th of March) SCS/SSS decided to move HTN (Home Theater Network) and SPN (Satellite Programming Network) to transponder 21 during March. This left KTVU up 'full time' (i.e. for their full broadcast day) on transponder 1. Therefore several pages of copy we created about the 'split-schedule' of KTVU was out of date on the date it went into the mails.

Had we published the super-station story back in our February issue, as we had originally intended, we could now 'claim' that the appearance of the story might have had some bearing on getting KTVU up full time. The truth is Ed Taylor doesn't need anyone to suggest 'new ideas' to him; he is, as always, several steps ahead of the thundering herd.

Collecting CATJ

For reasons I don't totally understand there is something of a cult out there of CATJ fans. I haven't heard of a case where a collection of CATJs was specifically cited in a divorce decree dividing up property but it wouldn't surprise me if it happened.

I do know this. When we published the "52 Issue Index" of all articles, letters, news-briefs and so on in our January (1979) issue I warned Janet

Stone (our librarian) to be prepared for a modest increase in requests for Xerox copies of out-of-print CATJ articles. **Within weeks we had hundreds of requests.** Some of you chaps must have spent days working out five and six page typed lists of every article you wanted copied by our over-worked Xerox machine. To handle the influx of mail in this area we put on another person. Just going back and calculating how many pages (or dimes) were required to pay for these 5 and 6 page listings cost us a bundle in time and money. I saw one go out of here for more than $108 in Xeroxing fees. Good grief.

Enough is enough. I've got the message.

There are several options open. The best one is least likely to happen soon. That being, I take a full collection of CATJs (I hesitate to mention I have one for fear my house will be burgled) and with Susan and the two kids I retire to some remote spot like Cochise County, Arizona for say two months to work up an updated handbook for CATV. This is what should be done and certainly the first 35 to 40 issues of CATJ have enough material in them to create a super-duper 300 or 400 page "handbook" for CATV. But alas, if I took a couple of months off to do this you'd have to get by without CATJ for a couple of months. So that's a bad idea.

Another option is for someone to take a full set of CATJ's and microfilm the whole lot. All 2,704 pages or so. Actually, a chap named Jack O'Neil in Wisconsin came to me with this suggestion and for now it sounds like a good idea. There's only one problem . . .I'm not letting **my collection** out of here to get the job done! So here's the deal. Surely in the area of Wisconsin/Minnesota/Iowa there is somebody out there willing to loan (insure it if you wish against loss) the full set to Jack O'Neil. He works for an educational institution that is deeply involved in creating a CATV training course so he has two axes to grind; he was frustrated in getting his own reference set for the value it would have in preparing his CATV technician's study course for his school, and, he figures that if that many people are into collecting old CATJs that somebody had better get it on microfilm; and soon.

You can find Jack at area code 608/342-1379. Anyone who figures their own set is taking up space could contact Jack to donate it to a worthy educational institution. You might even write if off your income tax if we could figure out just how much a complete set is worth. In that regard I've heard of full sets selling for around $250. Am I high or low???

ASN-Chapter 29

Remember ASN. . .the much up and much down (Common) carrier promising to bring up three indies plus a movie channel over on WESTAR II?

Just one year ago we spent a large number of pages investigating their proposed CATV program service; to consist then of three indies (KTTV Los Angeles, WGN Chicago and WOR New York) plus a movie package of some sort. It was hot news at the time and they promised to demonstrate their service at NCTA New Orleans late in April of last year. Which they did and then they fell out of sight as one problem after another (mostly the FCC, but some financial) hopped up in their path.

Then ASN got temporary Common Carrier status for their three indies last November and started a period of 'testing'; a few hours here and there just to prove they were real.

ASN has been a subsidiary of Digital Communications, Inc.; a St. Petersburg (Florida) based firm that messes around the pay TV systems in hotels and the like. Digital in turn is owned by a group of private investors; many of them from Iowa, and most of those professional people like lawyers and dentists and so on. The whiz kid interwoven into Digital and ASN has been one Mike Paolini who you may recall from our feature last April is the guy who set up a satellite feed for the Joint Chiefs of Staff of the mining of Haiphong Harbor back during the Vietnam war exercise. Paolini is no dummy.

In fact he's very sharp. About six months ago Paolini got some people down in Costa Rica interested in putting in an over-the-air pay (as in subscription) television system. Mike, through Digital, did all of the work and a license was granted to put a channel 17 on the air. The programming would all be English, much of it simply off-the-air U.S. programming, and under Mike's plan they were going to butcher up the audio on the transmission and leave the video alone. Mike figured the video (unscrambled) would help sell the package. The new Costa Rican pay-TV system would sell on the street for $30 a month. Then Mike got interested in programming the station and quickly learned that off-shore programming rights are almost impossible to acquire. He learned, for example, that when pay movies are shot down into the Caribbean (such as Puerto Rico) that many of the movies must be taped and delayed 90 extra days from their satellite showing dates to adhere to the off-shore movie distribution agreements. Obviously that creates quite a logistics problem for somebody taking the feed off the bird; some programs can run in real time, others have to be delayed to satisfy the off-shore movie distribution agreements. A can of worms to say the least.

Then Mike decided the best thing to do was to simply go to someplace near-to-shore (such as the Bahamas) and tape the programs. Off-air, off-satellite and what have you. And bicycle the tapes down to Costa Rica for airing. **What about copyright?** Mike is no thief, but he doesn't care much for the red tape that encircles the world. **"My best thought was that after you tape the show you put a properly calculated amount of money into an** 'Escrow Account' **in the Bahamas and let them come after it. If they can prove they are entitled to it, they can have it!"**

Well, back to ASN. None of this has much to do with ASN; except that the Costa Rica deal seemed like a good one to the Iowa investors of Digital. Michael, meanwhile, was having trouble getting seed money put together for ASN. His Iowa investor group had cooled on ASN and their reluctance to pony up the money required to get it off the ground was holding back ASN's real start up.

So in early March Michael Paolini cut a deal with his Iowa investors. He got out of Digital and they got mostly out of ASN (they retain 20%). Paolini ended up with 80% of ASN. On the surface that sounds like Michael might have gotten the short end of the stick since ASN is not exactly making great progress these days. But you never want to count Mike out.

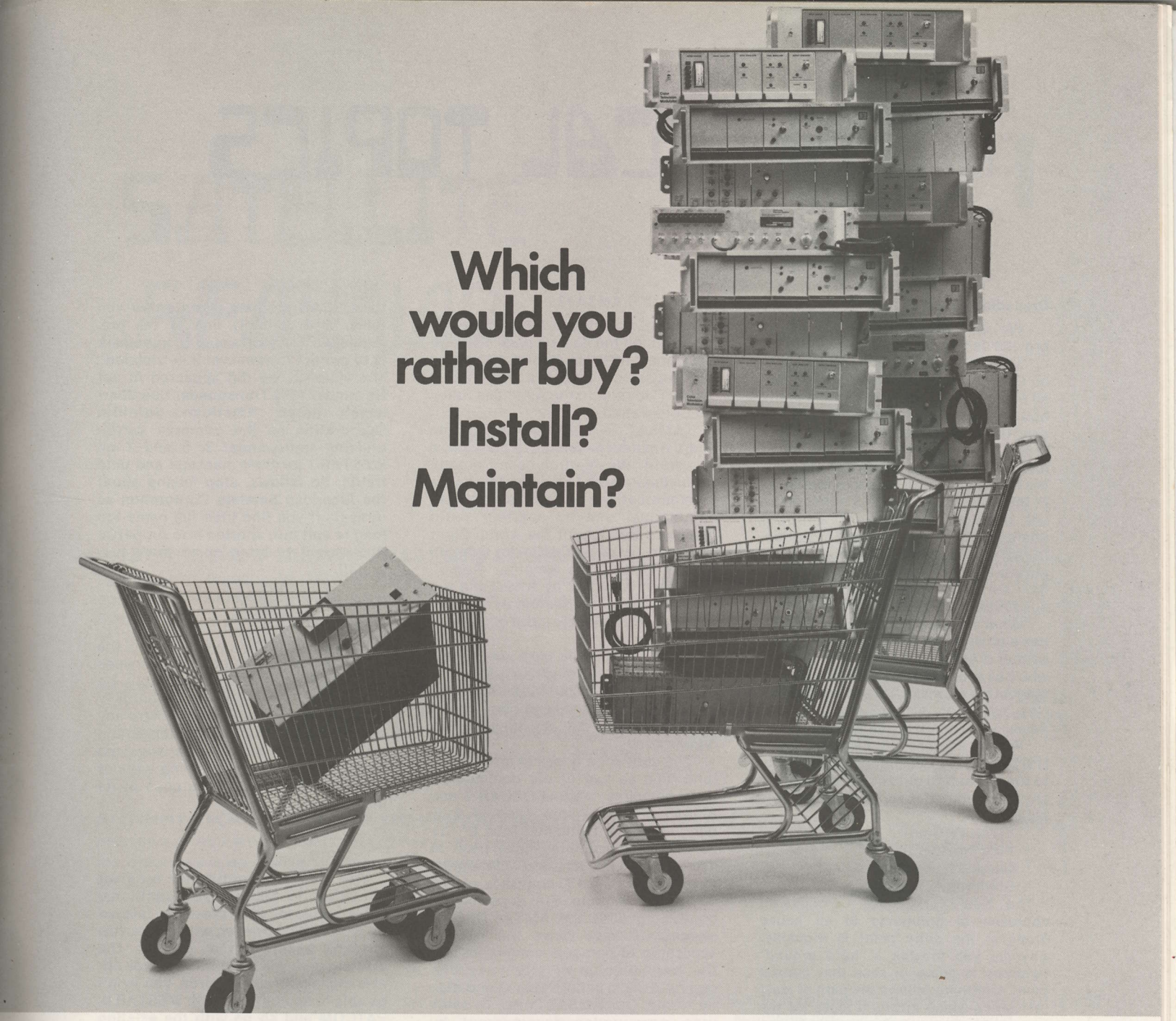
Then he went to some of the people in the cable business; a large MSO, a major program supplier and some others and he suggested that he would be willing to trade off a good part of his 80% in ASN in return for the seed money to get ASN started. He had some original ideas in this area also.

"We are commited to providing four channels for cable; three indies plus a movie package. I think that we might do very well if we took the HBO package and put it up on WESTAR." How's that again?

Mike's plan would take HBO off of transponder 24 from SATCOM, at the Western Union site only three miles up the road. He'd patch it back into the WESTAR board and back up and out over WESTAR. And only the eastern time zone feed because he has been told **"The eastern feed is the right one for the two eastern time zones, and even in the mountain time zone over half of the HBO systems prefer the eastern feed to the western feed".**

What would HBO have to say about this? They are interested enough to **talk** with Mike; they'd be compensated of course and be actively involved. No Bahama's Escrow Account for copyright here. In fact it might make good sense for HBO; to have themselves on two birds and adding a way to get emergency backup should SATCOM have a failure.

So ASN isn't dead. Not as long as Mike Paolini is still around alive and kicking. In fact, it may turn out to be a stronger package if some of Mike's plans can bear fruit. Michael meanwhile is not letting his lack of association with Digital keep him out of the off-shore subscription TV business. **"Acapulco looks good; so does Caracas. Who knows. . .they might have over-the-air subscription TV with English programming before the year is out."**



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.

There are even more advantages to Hughes AML design. Phase lock operation to minimize TV co-channel interference is one of these. We also feature VHF input to the transmitter and VHF output delivered right to the cable. And the entire FM broadcast band is just one channel to a Hughes AML system — no additional signal processors are needed.

How can Hughes AML systems offer so many advantages? Simple. Our patented AML system was designed and optimized specifically for CATV. It is now in its fourth-generation delivering more than 6000 video channels to distribution hubs around the world.

For more information on Hughes AML systems, write to Hughes Microwave Communications Products, P.O. Box 2999, Torrance, CA 90509. Or call (213) 534-2146. Before you fill your shopping carts.

Hughes AML Canadian distributor: Micro-Sat Communications, Ltd., 975 Brock Rd. South, Pickering, Ontario, Canada L1W3A4. (416) 839-5182.

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TECHNICAL TOPICS

Grounding Threat

"We are wondering if you could provide us with any help on a matter.

"The New York State Commission on Cable Television has mandated that all subscriber drops be grounded at the house. It is our analysis and experience over the past 19 years that subscriber drops connected to a well grounded mainline attract no electrical charges. We have never, in 19 years of operation in the Catskill Mtns, had a subscribers set damaged because of a power charge coming in over the CATV drop. In fact it is our analysis that putting a strong ground potential on the drop only serves to attract lightning to the subscribers house and set.

"What we were wondering is if CATA has a position on the grounding of subscriber drops? Do you know of any one who has ever done any research on this subject? If we make a stand against the New York State Commission on Cable Television what help can we get?

"We have reread the February issue (1975) of CATJ but that applies mostly to the grounding of tower sites. Is there any other material we can get on this subject?"

Stuart W. Smith
Vice President
Catskill Mt. Video, Inc.
Stanford, N.Y. 12167

The New York State Commission approach to grounding of all house drops at the entry point is arguable. Anytime you provide a 'hard ground' lightning is going to seek that ground point. Lightning follows the path of least resistance which means it looks for the lowest (ohmic) **resistance path to the ground potential. A cable drop that 'floats' usually doesn't look like much of a ground to lightning; it will typically be many tens of ohms above ground and the lightning will follow some other path in its seeking of ground. And when you ground a cable drop to a 'hard'** (low ohmic path) **ground** (through a ground rod that is attached to the sheath or shielding on the cable) **you may be creating additional problems. The transformerless** (i.e. 'AC-DC') **television receivers, for example, have one side of their AC circuit on the chassis. If the cable drop is not run very carefully you can end up with the chassis-AC back out onto the shield of the drop and to ground.**

Frank Bias of Tele-Vue in Pleasanton, California is the chap we believe most knowledgeable in this area. For those systems having some difficulty with the drop-grounding requirement, we suggest you give Frank a call at 415-829-1811.

AMSAT NOT AMSAT?

"One of your readers has called to our attention the item on page 43 of the November 1978 issue of CATJ. Your item repeatedly uses the abbreviation 'AMSAT' to refer to the American Satellite Corporation.

" 'AMSAT' is the trademark of the Radio Amateur Satellite Corporation, a non-profit, Washington-based organization created ten years ago to provide communications satellites for non-commercial use by amateur radio operators throughout the world. Eight satellites, called OSCAR's (for **O**rbiting **S**atellites **C**arrying **A**mateur **R**adio), have been launched by NASA and the U.S. Air Force as secondary ('Piggyback') payloads where extra space was available.

"As you can verify from their press releases, the American Satellite Corporation does not use the trade name 'AMSAT' because of conflict and confusion with the activities of our organization.

"The confusion arises at an inopportune time as two of our communications satellites, AMSAT-OSCAR 7 and AMSAT-OSCAR 8 have been in daily operation for a combined total of five years. These satellites have been in use by over 5,000 amateur radio operators in more than 100 countries and all 50 states. Among the experiments conducted with the AMSAT-OSCAR spacecraft have been the remote accessing of personal computers and the transmission of electro-cardiographs (ECG's) in both analog and digital forms. Our AMSAT-Phase III satellites now under development by AMSAT and AMSAT-Deutschland, e.v., our West German affiliate organization, contains RCA COSMAC microprocessors which control all operation of the spacecraft, including telemetry data formatting and command decoding."

Dr. Perry I. Klein
President
AMSAT
Washington, D.C. 20044

AMSAT is indeed the registered **trademark of the Radio Amateur Satellite Corporation. And indeed, American Satellite Corporation apparently respects this registration by avoiding any abbreviation similar to** 'AMSAT' **in their own releases. However, in the satellite systems business virtually everyone we know refers to American Sateliite Corporation as 'Amsat'** (or 'AMSAT' if you say it loud and for emphasis!). **We were troubled by this for some time because of the conflict with the OSCAR program operated by you folks. And certainly one of the prerequisites to maintaining a trademark is to protect it whenever it is 'violated'. The violation we did appeared in our November 1978 Transponder Use Chart which listed American Satellite Corporation as the common carrier utilizing transponder 3, 5 and 7 on WESTAR I for their message and data traffic. So fellows, stop talking about the American Satellite Corporation as 'Amsat'. If you find their full name too long to spit out, shorten it to AmSatCo (that ought to bring some more protests!).**

Dual Use Of Dish?

"Local WSJK-TV here is using the WESTAR I satellite for video services reception. WUOT will probably be sharing the receive system eventually for audio feeds. Question: is there any way to 'share' that dish antenna and electronics so that other services can be 'pulled' off of the antenna without upsetting the intended purpose of its installation?"

G. Hauser
Knoxville, Tn.
37916

You can add additional receiver (modules) to take-off any additional video, audio or data channels relayed by WESTAR I; however, with the narrow antenna beamwidth or pattern, the existing dish will be of no value for off-axis signals. In other words, you won't be able to do any good with WESTAR II, SATCOM and so on with the existing antenna/LNA. Not unless WSJK is willing to go along with you!

Experimental License Package

"Until recently I was unsure of how or if I would pursue the design and construction of an experimental (TVRO) terminal. Now I have made up my mind and I wish to take advantage of the $5. "Experimental Terminal License Application Package" described in Coop's Cable Column for April of 1978.

I also wish to comment on CATJ. SUPER appears to be about the best word that I am able to muster to describe my feelings about CATJ. I was one of the charter subscribers although I dropped out for a period of time. Since then I have sought back issues to complete my collection; but have found that to be a lost cause. I find Bob Cooper's column most enlightening. Thank you, again, for such a

bright star in my monthly readings. Out of some thirty-seven weekly, bi-weekly and monthly publications, I find CATJ is at the top of my list. Keep up the good work".

W.L. McIver, Jr.
Telecommunications Engineer
Chapel Hill, N.C.

The "Experimental Terminal License Application Package" was originally described in the April 1978 issue. It shows how you go about applying for a private, experimental license, and the price is $5.

Stressed Dish

"You'll be pleasantly surprised if you check into the August 1972 issue of QST Magazine, or the (current) ARRL handbook. Look at the 12 foot stressed dish by Knadle. It is quite a project but I plan to build one, and expect to mount it equatorially and aiming it with a hinged axis at Polaris and then shimming the north end up 6.25 degrees so the antenna will only have to be moved with the ascenion control to scan the various satellites. An article in CATJ describing such an antenna might interest many readers."

Travis Brackeen
St. Louis, Mo. 63112

The Dick Knadle dish has been fairly widely duplicated by amateurs. A completely re-designed approach has been followed by Jim Vines of Paraframe (see October 1978 **CATJ,** page 22) **with his 16 foot "kit" that is now ready to roll. Anyone with a home-built 12 or 16 footer that would like to share its design with the world will find us receptive to publishing an article however.**

COOP's QST Column

"It was a pleasant surprise to read your column in (the March) **QST.** I've just recently been exposed to satellite TVRO. I am trying to put it all together, and you apparently are up to your eyeballs in this thing.

"The (October CATJ) information on six foot dishes was very informative and I recently acquired one to use for my TVRO. The CATJ literature was received several weeks ago and along with some information from Paul Shuch at Microcomm I'm well on my way.

"I work here at Honeywell (Minneapolis) handling the Anechoic chamber in the 150 MHz up region. The 'gang' here is quite enthused about TVROs and we are designing an LNA for my system, hopefully with a 2-3 dB noise figure. I expect to bring the dish into the chamber to make gain and pattern measurements and to figure out a feed for it. If everything goes smoothly it will be installed on my garage by the end of spring."

Bob Clark, WØQIN
Edina, Mn. 55435

With the high number of new CATJ readers, many of whom are licensed amateur operators, this might be a good place to mention a couple of relevant things. QST magazine twisted Coop's arm back last December asking that he conduct a monthly column dealing with amateur communication systems about 1 Gig. That column began in March. Of the thousands of hams who have written in recent months, one of the more oft asked questions is "...can't people who are interested in exploring the challenge of private TVROs get together on the air to discuss this?". **What they mean is some type of organized net-type activity. Basically, Coop agrees this is not a bad idea although he sees a couple of problems. The primary one is that amateur radio is supposed to be non-commercial and because he has a professional stake in TVROs if he got** directly **involved in leading an amateur net discussion on the topic it might be construed to be profiteering through his ham license. Still, the need to exchange data is becoming more and more acute and there should be a solution to this. If somebody else with a 'big signal' would like to serve as coordinator for such a net** (say Sundays on 10 meters using backscatter for fill in) **or** (shudder) **20 meters we'll help publicize it here. The next problem, he forecasts, will be the size of the net. It is apt to get out of hand very quickly...if only 5% of the total people writing to ask about this checked-in, the first hour would be used up taking check ins! Still it is worth a try so let's hear from some volunteers. Coop promises to check in like anybody else, when he is able. In the interim** W5KHT is **often found on ten meters where he is chasing countries and he leaves a receiver running on the informal "VHF Propagation Net" exchange frequency of** 28.885 MHz **where the six meter DX crowd hangs out to exchange 50 MHz band condition reports.**

Microdyne TVRO's Move

Microdyne Corporation has relocated it's CATV TVRO receiver manufacturing headquarters to Ocala, Florida where a new 40,000 square foot facility has been activated. Microdyne personnel George Bell and Jerry Thorne, both familiar to CATV operators, can now be reached at (Microdyne Corporation), P.O. Box 7213, Ocala, Florida 32670 **(904-687-4633).**

SA Offers Training Course

The Cable Communications Division of **Scientific Atlanta** recently held (January 23-25) a three day training course (seminar) in Atlanta during which attendees were given a complete day each on headend systems, distribution systems and earth stations.

The next series of these training programs is now scheduled for **April 17, 18 and 19;** again in Atlanta. System personnel interested in attending the April session should contact Pat Rooney at 404-491-5775.

Broadcasters To Satellite?

At a broadcast industry conference in mid-March RCA Americom announced plans to build, install, operate and maintain 725 receive-only earth stations for the nation's commercial television stations; **without charge** to the television stations.

The innovative plan calls for RCA to provide the terminals and with the 'razor' in place RCA would bring satellite distribution of network and non-network programming to the TV stations through one or more RCA domestic satellites. RCA says they hope to 'test' the project around mid-1979. All of the commercial TV networking will be 'scrambled' according to RCA **"...so that only authorized stations can receive the broadcasts..."**. Initial tests will begin when Viacom and Post-Newsweek stations (Detroit, Jacksonville, Hartford and Miami) cooperate in the feeding of programs and movies. One source suggests that group broadcast owners, such as Post-Newsweek, may be planning to schedule movies to run in all of their stations either at the same time or on a tape-delayed basis with the satellite being the feed and distribution mechanism.

The broadcast industry has been filled with unconfirmed 'rumors' about the 'discovery of satellite networking' by the broadcast interests for several months. The RCA plan, apparently designed to 'blunt' whatever move ATT/GT&E may have up their sleeves for later this year when it is anticipated the COMSTAR birds will be authorized to begin carrying domestic video traffic, **"...was anticipated"** by several sources.

RCA sources say that the earth stations will be 5 meter Scientific-Atlanta terminals, the encoding system to be employed will be 'addressable' to individual stations and the decoding will function only when the individual stations dial in the appropriate decoding sequence for the particular feed. Many of the programs will be shipped via satellite in 'off-peak-times', or during the nighttime and other hours when live network feeds are not required. Stations will simply dial up their VTR recording facilities to tape the feeds as they come down the line from the satellite, and arrange the programming schedules to suit their own market needs.

The impact of the announcement in the broadcast industry was immediate; ripples were still being felt ten days later as the impacted parties (ATT long lines for one) were pressed to sort it out and provide their own responses. RCA's decision to provide each television station in the country with a terminal (projected costs of more than $20,000,000) was seen as being especially dramatic and several industry sources felt that "RCA has done it's homework". One source responded that he felt RCA may have moved the eventual movement to satellite distribution by networks "ahead by several years".

Canada Approves TVROs

On February 27th Jeanne Sauve, Canadian Minister of Telecommunications, brought to an end the monopoly of earth terminal ownership by the Canadian Telesat consortium (see page 18, October 1978 **CATJ** and page 54 March 1979 **CATJ**). The move, widely acclaimed in Canada by cable system operators, appears to be something less than most Canadian systems would have desired however.

Under the new policy, ownership of earth terminals will no longer be limited to the Telesat operation. In the past, if someone wished to utilize the services of the ANIK series geostationary satellites, they had to contract with Telesat for the satellite time, pay Telesat to install a TVRO terminal, and then pay an on-going charge for both the satellite time and the use of the terminal. Under the new policy, Canadian cable systems (and others including apparently broadcasting stations and private individuals) **can purchase their own** earth terminals although the services they receive (through ANIK) must still be contracted for with Telesat.

The preliminary announcements indicate that new Canadian terminals must:

1) be at least **4.5 meter** in diameter
2) maintain **3.0 dB** signal margin (i.e.

CATV TVRO STATISTICS — APR. 1979

Applications Filed/FCC	Dec. 1978	Jan. 1979	Feb. 1979
1) 11 meter	0	0	0
2) 10 meter	1	1	2
3) 7 meter	2	3	0
4) 6 meter	6	5	4
5) 5 meter	56	70	64
6) 4.5 meter	6	16	12
Total Apps.	**71**	**95**	**82**
Cost Max.	$106,820	$60,000	$103,000
Cost Min.	$12,600	$17,500	11,200
Avg. Cost	**$31,431**	**$31,597**	**31,323**
Channels Requested*	173	201	181
Average Channels	2.4	2.1	2.2
Requesting WTCG	40	43	40
Requesting CBN	21	44	35
Requesting HBO	37	51	39
Requesting MSGE	12	17	13
Requesting SHOWTIME	14	6	9
Requesting WGN	10	12	13
Requesting KTVU	3	6	5
Requesting Warner's Nickleodeon	13	0	9
Avg. Cost Per Channel	**$12,935***	**$14,975***	**$14,237***
TVRO's Licensed/FCC	**73**	**76**	**75**

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.

excess C/N over receiver threshold)

3) go through some type of **frequency coordination** (search) similar to that now employed in the United States.

Can Canadian cable systems expect to receive permission to access U.S. satellites? **No.** The question of accessing U.S. satellites ('legally') was not broached in the announced new policy except by footnote which states that reception permission will be limited to Canadian satellites and services.

The status of Canadian cable systems (and other 'licensed' or legal terminals) vis-a-vis accessing U.S. terminals seems to be buried in high diplomatic channel manuevering. At the present time some 'talks' are underway between the U.S. State Department and their Canadian counterparts. The U.S. State Department is leaning on the NTIA for guidance in this area. There are two primary problems to be resolved and perhaps they are in fact not capable of being resolved:

1) ANIK, like SATCOM, WESTAR, and COMSTAR, is 'licensed' by the respective government for 'domestic telecommunication relay'. That simply means that each government authorizes the launch, positioning and operation of the respective satellite(s) for the relaying of material **within** the borders of that country.

2) All **international** communications (i.e. **between** two or more nations) is, by international agreement, limited or reserved to the INTELSAT family of satellites; and the United States serves as 'operational manager' for INTELSAT through COMSAT.

For the U.S. (and Canadian) government to allow the satellites of the **other country** to provide service to their own regulated uses would be contrary to the INTELSAT agreements. In a nutshell, it would 'look bad' to other nations of the world who have joined INTELSAT and who support it if the U.S. went off and allowed Canadian (ground stations) to access (legally) U.S. satellites, or vice versa.

It all sounds very doubtful at the moment, and it is providing both the Canadian and U.S. governments with a convenient crutch with which to dodge the real issue of need. INTELSAT readily provides transponder time (on rental or lease) to nations carrying on communication relay entirely **within their own** country (Algeria, Sudan, etc.) but when the opposite is proposed INTELSAT has rather strong objections.

There is some precedence however; the Indonesian Palapa domestic satellites (see **CATJ** for August 1978, page 40-B) does 'lease' transponders to at least two neighboring countries (Phillipines and Brunei).

So what appears to be in store for the Canadian cable operators? Before the terminals will be worthwhile, there must be something on ANIK of value. The present ANIK video services consist of a pair of CBC Northern channels (English) plus a CBC French channel. This service is generally available throughout the area of Canada where cable operates and in any event is not a pure 'broadcast' signal (as WTCG is when it is taken 'off-air' and sent out via SATCOM 1); rather it is a 'network feed'. This suggests that before the cart can begin to move in Canada the Canadian cable operators must come up with some programming that can be distributed via satellite, and which will pay the (high) Telesat tariffs. In that regard some are quite optimistic. **Philip Lind,** Vice President of Rogers Cablecommunications, Ltd. predicts from 50 to 100 cable-system-installed TVRO terminals before fall comes. **Ted**

Jarmain, chairman of a recently revitalized 'Cable Satellite Network, Ltd.' predicts the group will file with the CRTC shortly for permission to operate the network via satellite. Jarmain sees the relaxation of TVRO system ownership as **"bringing the idea of pay television network closer to reality"** in Canada.

Early indications are that a Canadian cable industry operated single (or dual) channel package will evolve on paper over the next month or two. The network will contract for time from the Telesat operated ANIK satellite and develop its own programming package(s) along lines that might include entertainment, movies, and public service utilizing both foreign (i.e. U.S.) and Canadian programming sources.

RCA Goes For Fourth Bird

RCA American Communications, Inc. applied to the Federal Communications Commission early in March for permission to construct a **fourth** SATCOM satellite. RCA is already on file at the FCC to launch SATCOM F3, between October and December of this year (see **CATJ** for January, page 44) and by placing F3 into orbit RCA will at that point have no 'spare' satellite on the ground. RCA is requesting permission to construct a fourth satellite which they say will be identical to the F3 configuration (24 channels with enlarged power capacity and four reserve TWT output stages). The F4 bird will serve as an 'on-ground' spare for the interim period, although RCA also announced that it has asked NASA for an April 1981 launch date on the Space Shuttle. SATCOM F4 will be designed so that it can be launched by either a Thor Delta launch vehicle, or by the Space Shuttle.

The Space Shuttle program now appears to be running far enough behind that the most likely date for the **first** use of the system to place satellites into orbit is now in the first quarter of 1980.

HBO 'Take Two' Scheduled Up

The Home Box Office 'family program' premium service, 'Take 2', is scheduled for a 'launch date' during April according to HBO. The new 'second level' service from HBO will be on vertical transponder 23.

More than a dozen systems have signed up to take the service at the sign-on date, including Louisville, Ky., Fort Lauderdale, Fl., Syracuse, N.Y., Orange and Los Angeles County, California. Take 2 is a $3.95 to $5.95 rate service featuring G and GP movies in a 'Movie Of The Week' format (Convoy, F.I.S.T., The Spy Who Loved Me, Outlaw Blues and Bobby Deerfield are scheduled during April) plus four special program categories designed to appeal to different viewing interests of family members.

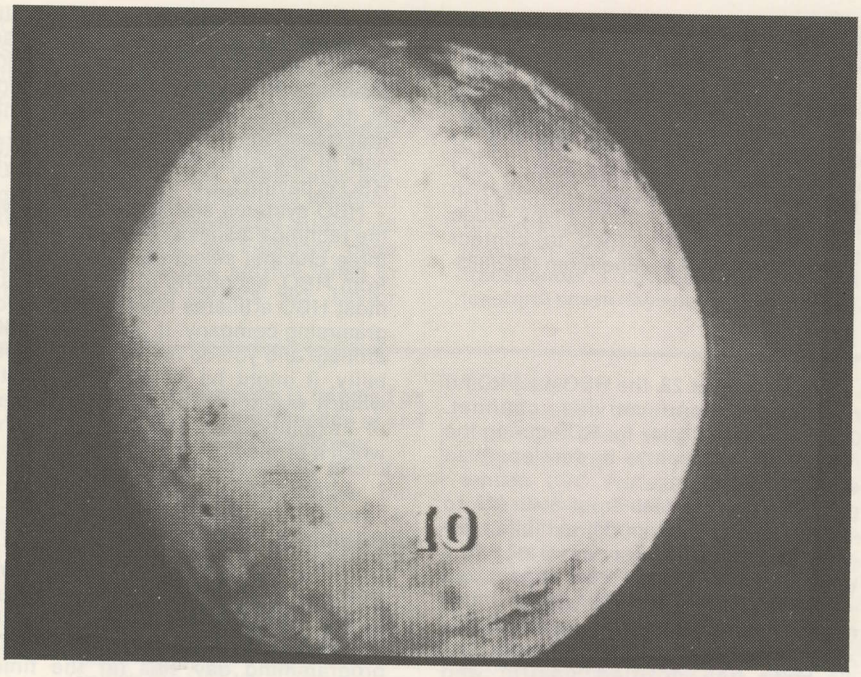
Nickeloden Starts Late

Warner Cable's children's entertainment and information network service via satellite, Nickelodeon, officially inaugerated service on March 26 on transponder 11 of SATCOM F1. Warner notified the industry early in March that it could 'tune in' Nickelodeon for the week of March 26th through the 31st of March at "no charge", as a means of previewing the service and showing cable subscribers what the service was like.

Nickelodeon is up from 10 AM to 11 PM eastern seven days a week on transponder 11 with Star Channel movie service coming on transponder 11 after the Nickelodeon sign off. The Nickelodeon rate is 10 cents per subscriber home per month.

NOW - 'Live From Jupiter. . .'

Satellite television transmission was put to an unusual use over the weekend of March 4-5-6 when the Jet Propulsion Laboratory (JPL) at Pasadena, California leased time on transponders 16 and 10 of SATCOM F1. Starting at 12 noon (eastern) on the 4th and for four hours on each of the three days JPL in cooperation with NASA provided a total of 12 hours of 'live' and often colorful coverage of the Voyager I space probe 'Flyby' of the planet



Jupiter. The best part is that **the 12 hours of television coverage** of this scientific first and historical event **was free** to anyone who wished to use it, and cable systems were actually encouraged to use the transmissions.

JPL and NASA had hoped to be able to approve the live coverage months prior to the 'Flyby' but someplace between the desire and the implementation there was a paperwork snafu. Just days prior to the acutal Flyby the pieces fell together and RCA Americom's Gene Boyle began to get the word out to cable system operators and others equipped with earth terminals.

The system worked in this way. Voyager I is equipped with a number of sophisticated CCD video camera systems. As Voyager I approached Jupiter (March 4), passed by at its closest point (177,000 miles on March 5th) and then passed on 'around' the largest of all solar system planets (March 6th) the special cameras were trained on pre-determined portions of the planet and its many 'natural' satellites. The pictures were converted to RF transmissions and sent back to earth (a 38 minute trip by the way, even at 186,000 miles per second) where they were received by one of several deep-space earth terminals. The terminal assigned the job of being the primary recipient of the RF messages then sent the data onto JPL at Pasadena via geostationary satellite. There JPL processed the received data and using computerized video techniques recreated television 'pictures' of the views of Jupiter and the Jupiter satellites as seen by Voyager.

These 'views' plus a most interesting running commentary and background information was then 'packaged' into yet another television 'program' which was sent via SATCOM F1 (transponders 10 and 16) for a total of 12 hours spread over 3 days.

NASA pushed that the 'program' be made available to cable systems and others, at **no charge** and RCA readily agreed (since NASA was picking up the tab for use of the transponders on F1 anyhow) provided NASA signed a release to that effect. When it all finally came together on February 28th word slowly began to drift out to cable operators through equipment suppliers.

Now there appears there is at least a 50-50 chance that the same type of approach may be followed when Voyager II passes by Jupiter on its own 'Flyby' during July. And beyond Jupiter comes other 'Flybys' for the pair of Voyager birds involving Saturn and Uranus. Cable systems interested in being alerted to the next 'Flyby' video transmissions are urged to contact **Gene Boyle** at RCA Americom **(202/885-4181).**

22 Burps

Transponder 22, the HBO pacific and mountain zone service channel, produced a surprise for RCA during the month of February; it developed an intermittent 'burp'.

On February 17th from 8:40 AM to 9:12 AM the transponder exhibited 'erractic' behavior for several short periods of time. Then again on February 28th at 11:27 PM (these are all EST) the transponder shut down for approximately five minutes time.

HBO has notified pacific and mountain zone affiliates that if the problem becomes substantial or regular that they will promptly transfer the western zone feed to backup transponder 20. At the same time RCA will go into a huddle to determine which of the pre-emptible transponder users will be 'bumped' to re-establish a spare or backup transponder for HBO. Thus the failure (or partial failure) of 22 would affect several transponders; 22 itself, 20 (which would become the in-use backup for 22), and another **non**-HBO channel which would be 'pre-empted' of its regular user in favor of making that transponder available to HBO as a part of the guaranteed service which HBO is paying for.

HBO systems are supposed to have the technical capacity to switch over a three channel selection, on command from HBO, according to the contracts most HBO affiliates have with the programming company. If you are an HBO affiliate and you do not have this capability, it might be wise to check into what it would take to gain this degree of flexibility since the day may come when it is needed.

Clearing Up KTVU

In the March issue of **CATJ** there appeared a report on the current status of the 'Super Stations', KTVU, WGN and WTCG. That report noted KTVU's programming day was (at the time) being 'clipped' on the front end and in the middle by common carrier SCS for the addition of SPN programming in the morning hours (eastern) and HTN premium movie programming in the prime time evening hours (eastern).

On March 1st SCS moved the HTN evening premium movie to transponder 21 (which SCS received in exchange for transponder 13 which had failed last

October) and around the first of May SPN programming will also shift to transponder 21. KTVU now runs 'unclipped' or non-interrupted.

Transponder 21 **had been** targeted for a new group that promised to bring up a 24 hour per day 'cable only' programming service which they intended to operate as an advertiser supported service (see **CATJ** for February, page 43). However the new service failed to materialize and SCS's Ed Taylor decided to use the available 21 to separate the three services that were at that time sharing transponder 1.

At the present time SCS/SSS operates its own uplink in the Atlanta area bringing up WTCG and UPI Newstime on transponder 6, plus, it brings up HTN programming on transponder 21 on weekdays between 8 PM and 10 PM (eastern) and SPN programming on transponder 1 between 7 and 10 AM (eastern) seven days per week.

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);
2) **Member-systems** pay regular dues to CATA on a monthly basis; Associate members pay a one time annual fee; "Individual" members pay a one time annual fee of $25.00 per year.
3) **CLASSY-CAT advertising is also available** to **non**-members at the following rates: **50 cents per word** with a minimum per insertion of $20.00. A charge of $2.00 per insertion is made for blind-box numbers or reply service.
4) **Deadlines** are the 15th of each month for the following month's issue.
5) **Terms** for non-members is **full payment with order** (no invoicing).
6) **Address** all CLASSY-CAT material to: CLASSY-CAT Advertising, CATJ, Suite 106, 4209 NW 23rd Oklahoma City, Ok. 73107.

USED EQUIPMENT WANTED
Strips, Line and Extender Amplifiers, Filters, Traps, Pre-Amps, Converters, Cable, Hardware and other basics. Any condition. Age no factor. Reply to: Allan Fern, Box 15013, Pikesville, MD 21208 or call 301-484-2030.

FOR SALE: VIKOA Weather-Caster, Texas Electronics weather sensors and 6 card message holder. Telephone 517-479-6160.

FOR SALE:
"Complete studio and production outfit featuring two Sharp XC 2000 color cameras with dollies and zoom lenses. JVC Porta-pack ENG camera with recorder, Panasonic 9500 Editing system complete, Lowell and Smith-Victor lighting kits, Digitrol microprocessor VTR controller with 4 Sony 2800 VTR's, 3 Systamatic VJB-12 automated cassette machines, Shintron special effects console, audio console, etc. First offer of $40,000 takes all. Gene Cooper 312-759-4600.

First class condition: 1977 one ton Chevrolet Van with electric van ladder. 350V8 engine; P.S.; P.B.; Turbohydramatic; H.D. shocks; stabilizer; aux. seat. $6500.00.
Also: 1965 3/4 ton 4-wheel drive Chevrolet ladder truck. Good engine, needs some body work. $500.00.
Wire Tele-View Corp. 428 E. Norwegian St. Pottsville, Pa. 17901 Phone: 717-622-4501

System Technicians—Openings are now available for qualified technicians. Must be able to handle routine service calls. System located in the sunny southwest. Send qualifications and references and include financial requirements to:
Chief Engineer
P.O. Box 20011
El Paso, TX 79901

FOR SALE
1 MA-12XC Microwave Associates Cars Band Link on A-2, 4 Andrew antennas for above, Tomco De-Mod and Blonder-Tongue modulator. All never used and available now. Call (714) 873-5025 days and (714) 873-6846 nights.

VURITE, Inc., a 260-70 sub. system, is for sale. Located in a resort area 80 miles east of Modesto California at 5000 ft. elevation, in an area called Pinecrest. It has 12 channel capacity with six in use. Have unbuilt Franchise with considerably more expansion room. Present operator needs to retire. Ph. 209-586-4475.
C.B. Herring Star Rt. Box 1187, Sonora, California 95370

CABLE TELEVISION INSTRUCTOR
Post-Secondary Institution needs second year instructor to teach all aspects of reception/transmission and studio reproduction.
QUALIFICATIONS: 6000 hours recent relevant occupational experience and two year Vocational Technical related education.
APPLY TO: Director, Wadena Area Vocational-Technical Institute, P.O. Box 267, Wadena, MN 56482 (218) 631-3342.

For Sale: Telemation TMW97 Weather Scan complete with GE camera and all weather sensors $1500.00 Excellent condition. Phone (614) 676-7911, John Nowak, Bellaire Antenna Systems, Bellaire, Oh.

FOR SALE
USED EARTH STATION EQUIPMENT.
Dish Antennas 4 feet to 60 feet; Remote Controlled Pedistals; Various Sizes of FOAM and AIR dielectric COAX CABLES; Permanent and Portable Towers; and other used communication equipment. (305) 452-1598 nights. C.H. Bell, 480 San Cristobal, Merritt Isl., Fla. 32952

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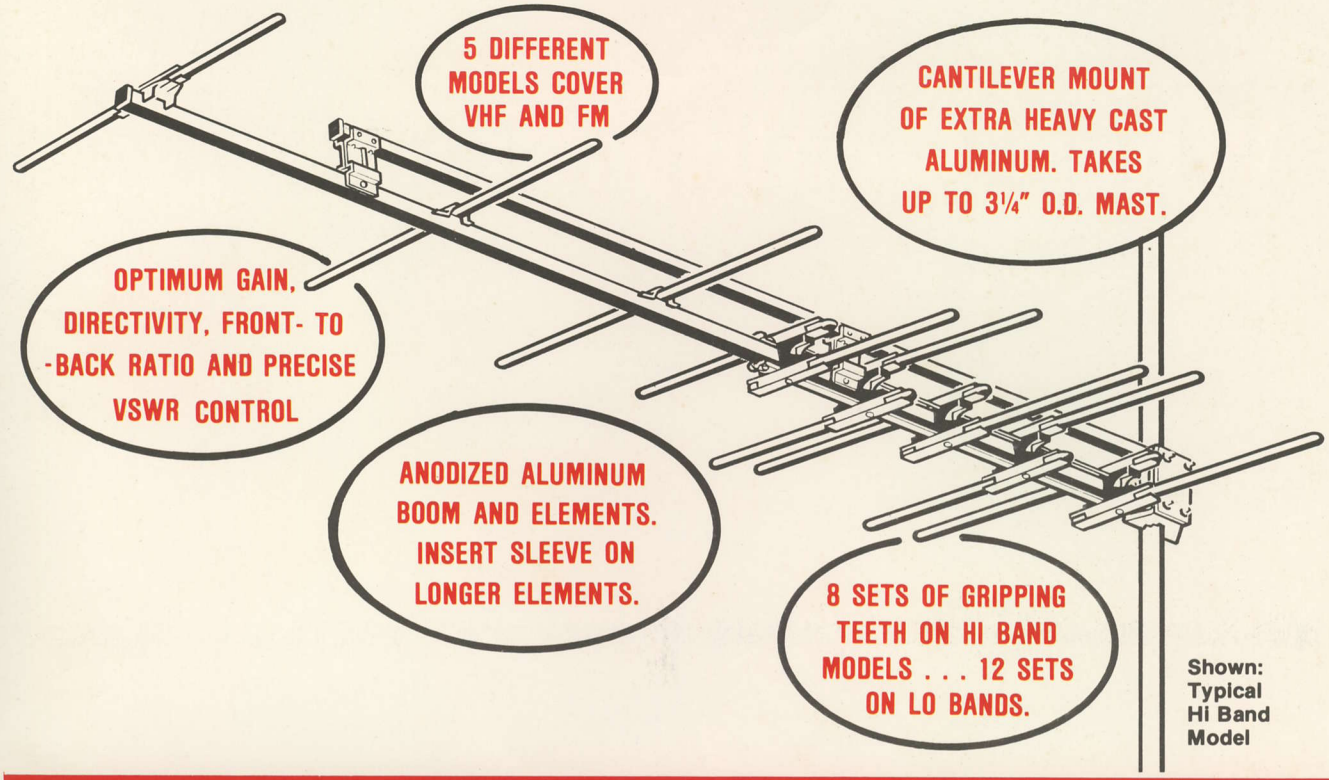

Shown: Typical Hi Band Model

WHERE GOOD TV PICTURES BEGIN
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HIGHER GAIN, LONGER LIFE, LOWER PRICE

Design of Winegard's new line of CATV yagis didn't begin until after we did our homework. First, our market research engineer talked with a lot of people in the CATV industry: operators, engineers and installers. He analyzed what they wanted in CATV antennas and then we put our antenna design engineers to work.

When prototypes were ready we took them into the field for testing and reaction. Some minor modifications were suggested and we made them. The result is an outstanding line of CATV antennas with higher gain, longer life and lower price than what you've been used to getting.

Before you put up another yagi, take a look at what Winegard has to offer. You'll like what you see and we'll save you some money on a first class product.

SPECIFICATIONS	CH-8024	CH-8046	CH-8071	CH-8113	CH-8060
Band Width MHz	54-72	66-88	174-198	198-216	88-108
Average dBi over Isotropic	9.5	10	13	14.8	10.6
Average Beam width ½ power pts.	58°	57°	43.5°	40°	67°
Average front-to-back ratio	26 dB	25.5 dB	26.5 dB	23.5 dB	26 dB

Detailed specifications including polar patterns are available on all models. Call or write address below and ask for ruggedized yagi specs.

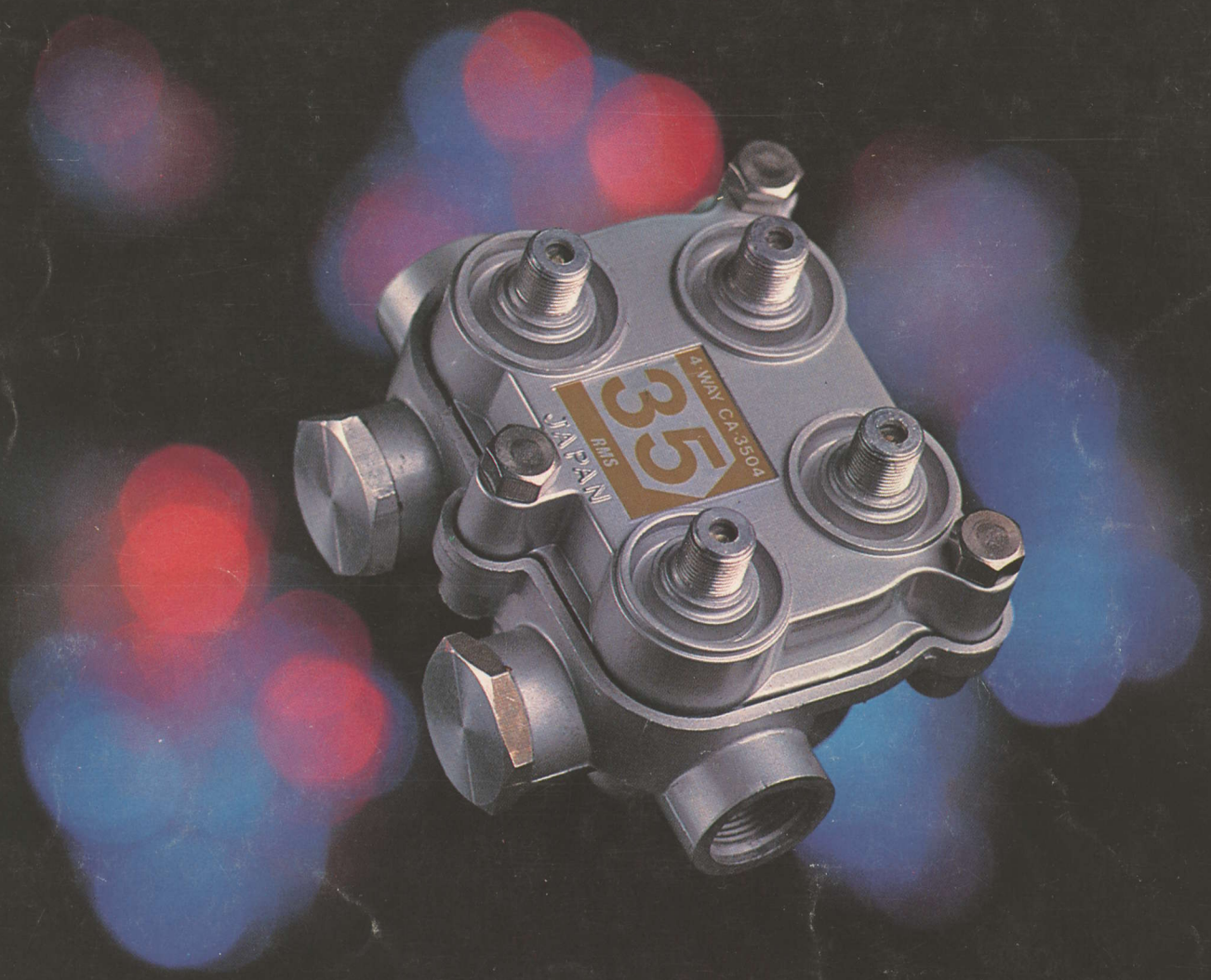
1979 — WINEGARDS 25th YEAR

NCTA SHOW — BOOTH 180

WINEGARD COMPANY, 3000 KIRKWOOD, BURLINGTON, IA. 52601

AC 319-753-0121, Ask for Dale Hemmie or Hans Rabong

When Quality Counts . . .



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