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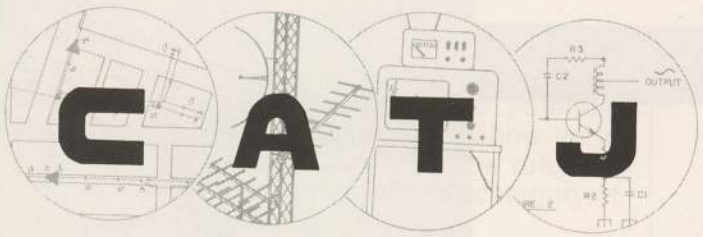

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OUR COVER

Blue sky. The right kind. Installing this new California CATV headend brings out the incentive to move ahead once again. The industry is starting to get back some of its old 'zing' as reported throughout this issue.

CATA-torial

KYLE D. MOORE, President of CATA, Inc.

The May Second Filing

Just when one begins to believe there is a modicum of common sense surfacing at the Commission, they go and do something dumb. The case in point is the recently passed May second date when all cable systems (with more than 499 subscribers) were supposed **to have** on file their signal-carriage-portions of their CAC applications. Now for those who joined us late, **originally** everyone with 50 or more subscribers was supposed to file for the record. This included several hundred (if not a thousand or more) pre-March-1972 systems that were grandfathered. Then this past January the Community Antenna Television Association asked the Commission to stay or put off the filing date for systems that were **likely to be exempted** from the filing requirement. The Commission agreed, and then on March 10th the Commission formally (and finally) voted to exempt all systems with fewer than 500 subscribers. At the time the Commission voted to increase the filing exemption from 50 to 500, they also stated, clearly we thought, that sometime very soon (Chairman Wiley has often been quoted as promising this before he leaves office June 30th) to extend that 500 number to 1,000.

So the stage is set. If you have fewer than 500 subscribers, you don't need to file at this time. (But your time will come, **as soon as** the Commission figures out what you are to file with them.) If you have between 500 and 1,000 subscribers, the FCC told you on one hand that sometime soon, probably this summer, you would be in the same boat as the below 500 subscriber systems. Then if you had over 1,000 subscribers, you had until May 2nd to file your CAC.

If you have between 500 and 1,000, were you to file? It seemed foolish on the surface. **Typical legal fees** for filing run between $300 to $400 if you have a **simple** application; but if you have added signals after 1966 and prior to 1972 with**out** filing an 1105 notice, you would have to seek a waiver for those signals "added" extra-legal. A waiver, we are told, "will be more or less routine". . .**but not guaranteed.** CATA surveyed member systems with between 500 and 1,000 subscribers and found 136 systems in that category. We checked with some of these and determined that around 70 of these (over 50%) had added signals with**out** 1105 notices. Most did so out of ignorance of the then-current FCC notice. The legal fees for pursuing a "simple" (meaning uncontested by a broadcaster) waiver and filing a CAC amounts to around $800 and it goes up from there if the system has broadcaster opposition. That's no fewer than 70 member systems, times $800 as a minimum, or $56,000 scheduled to be packed off to the Washington legal establishment.

Keep in mind that this is merely the tip of the iceberg, representing a small fraction of all systems in the 500 to 1,000 subscriber categorey. Also keep in mind that for systems between 500 and 1,000 subscribers, if Chairman Wiley is good to his word this expense is a total and absolute waste. **Money thrown down the drain.** Money for CAC's which will not be required. Probably many of the CAC applications that end up with waiver request attached will end up contested; that being the nature of the broadcasting establishment.

So here **you** are, with 650 subscribers, carrying one or more signals that technically require a waiver today, but which will not require a "waiver" **when** the exemption is raised to 1,000 subscribers. You puts up your money, and climbs into a "partnership" with one of the many fine Washington law firms and they begin the paper mill churning. And the broadcaster(s) objects and you put up some more bucks for some more legal time to push the waiver request. After you are say $800 or more down the road, the FCC comes through good to its word and tells you that you (1) don't need a waiver, and in fact (2) don't need a CAC either.

All the logic in the world suggested that the Commission would see this fiasco and grant some form of special filing relief for those systems between 500 and 1,000 subscribers. But they chose not to do so.

Most systems in this category fully expected the Commission to grant that relief. CATA expected the FCC to do so, and we advised our member systems in this range to "sit tight" because we felt **sure** that the Commission would not **deliberately** create a situation with so many inequities.

We were wrong. Alas, it's not the first time we've been wrong when dealing with the FCC. And it probably won't be the last.

Technical Revolution?

There is a new, refreshing attitude in the small system end of this business these days. It is in-

deed heartening to hear established system operators talking about building a new system or two, in towns with say 300 or 500 potential homes. The new attitudes began to show up in March, just after the FCC relaxed the rules on systems in the under 500 subscriber category. It has been building ever since.

We started a list of such systems in the planning and construction stages in March (a 'private' list we might add, in case someone is considering asking for it) and by mid-April the count was past 40.

At the same time the interest in new, small, systems is building, we are equally pleased to see the apparent **re**-birth of **new** CATV technology. As this issue of **CATJ** reports, there is a new "look" for low-cost microwave. It is bound to attract alot of sophism from people who have a hard time accepting that it **might** be possible to establish a single channel microwave link for a 5 to 15 mile path for say $3,000 (**with** antennas), **or less**. We've talked with a number of operators who report that with this **type** of low cost microwave available, they can see numerous additional, new small communities they can serve. And there is some cause to believe that **maybe** the cost of "low-cost" microwave may come down even further from the $3,000 per channel range. CCOS-77 may open quiet a few eyes in this regard.

As "good news" as the break through in low cost microwave **may** be, there is still other good news for a technology starved industry. We've seen two different approaches to low-cost, digital time/weather/information channels demonstrated recently; one for around $750.00 (with modulator) and another for about $1,000 (less modulator). And, this issue reports on the progress being made down at Broadband Engineering in Florida with plant **amplifier** re-builds (as opposed to plant re-builds with **new** amplifiers); a very significant step for getting perhaps more than 12 channels through a single ended plant. There are other "revolutionary" changes in technology on the horizon as well. One of these is in the head end processor department. There the price is not the important news; the quality of the signals and the new approaches to processing are (we'll look at these in our June issue).

Between the new approach to microwave, low cost digital information channels, and better (we hope) approaches to headend signal processing, we see major changes ahead in small town or rural cable. Until now, if a town was not able to support **its own** descrete headend, it didn't get wired unless it was within cable-extension distance of another larger community. With the advent of low cost microwave and these other technologies, we see a new breed of "hub" system springing up; a town with perhaps 700 subscribers serving as a "central control point" for several additional smaller towns around it with perhaps a few hundred homes in each of the

Continued—Page 31

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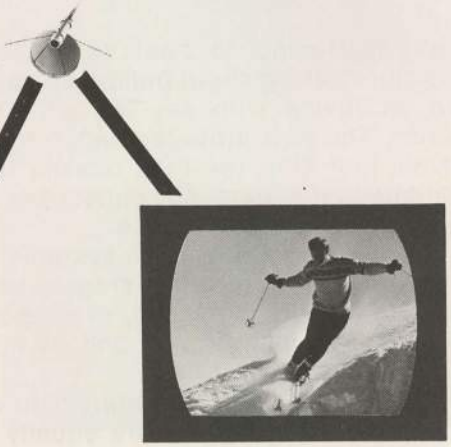

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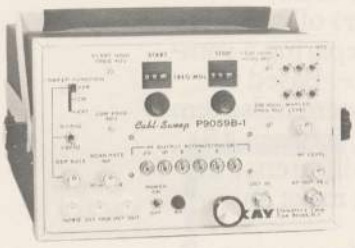

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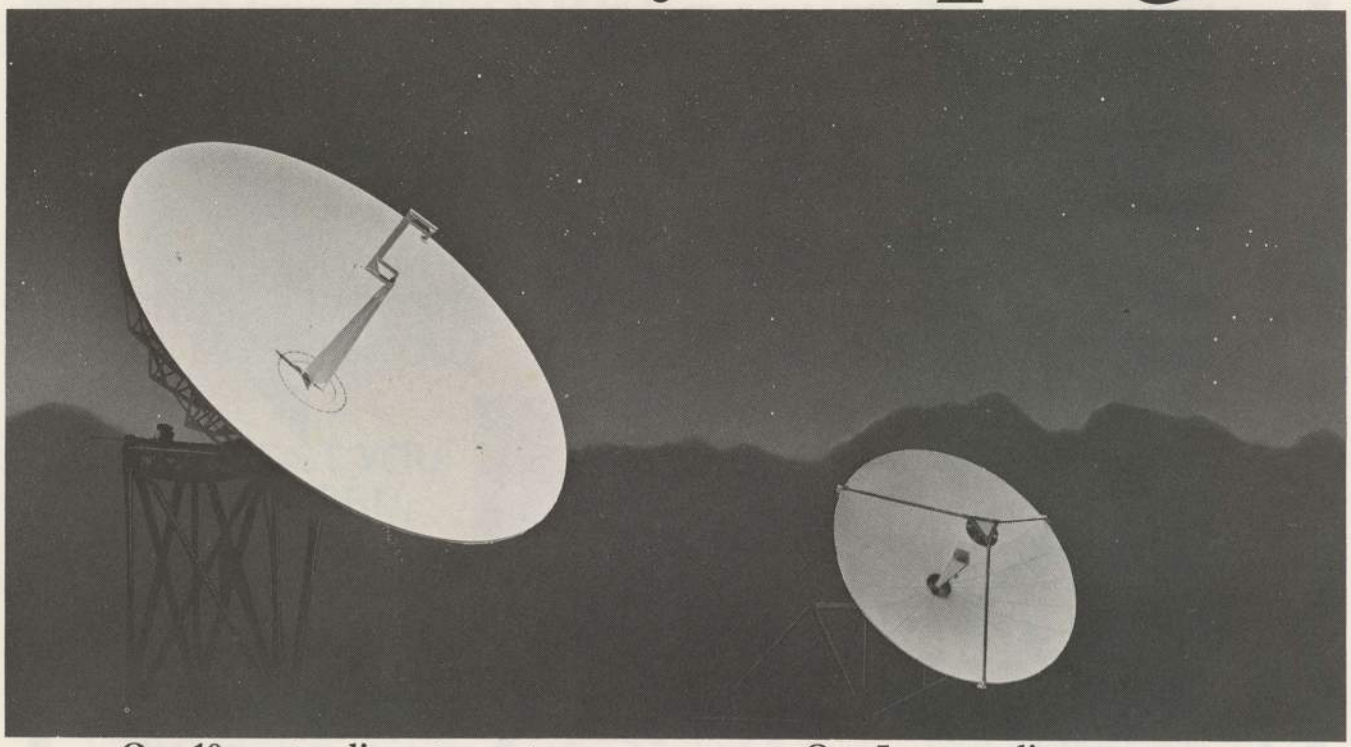

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On The Move Again. . .

The CATV industry, through a recent period of hard times with tight money and even tighter federal regulations, is on the move again. After nearly five years of depressed equipment sales and much lower new system construction rates than the industry suppliers were geared up to handle, there is strong evidence that a recovery is underway. Confidence is returning to **some** segments of the supplier market; new products are beginning to show up and much of the much-noted "technology gap" of the past five years may soon disappear.

For the record, there hasn't been much new to "look at" or consider purchasing for around five years. There have been minor changes in equipment; a handful of significant developments, but by in large very little new engineering has been done since around 1972-73. **And it shows.** In that interim period, whole new generations of descrete components (transistors, IC's, and diodes) have been developed, designed into equipment, and then replaced by even newer advances in semiconductor technology. But not in CATV.

When last CATV went through a "significant" period of new equipment development, most of the CATV equipment announced was designed around component parts (i.e. transistors, IC's, et al) which were themselves designed primarily if not exclusively for CATV applications. In the early 1970's, when it appeared to the electronics world that CATV **was** going to be investing in hundreds of thousands of new miles of plant in a short period of time, there was a considerable interest on the part of the descrete component manufacturers to "share in this explosion". So **they** devoted some portion of **their** own R and D budgets to the design of better transistors, chips, connectors and what all **for CATV applications.** When the CATV explosion did not occur "on cue", the component people wrote off CATV and went back to designing parts for mobile radio (CB for one), TV receivers, space communications and other areas where "growth" was expected. In a nutshell, component manufacturers are like anyone else; they'll put money into specific-application design **only as long** as they see **volume** sales resulting. CATV growth, as projected in the first couple of years of the 70's decade, **was** going to be **volume** growth. But CATV's **actual** growth, as represented by the system starts and the new system miles constructed during the 1972-1975 period was quite far back from the volume growth expected (or required) to sustain a reasonably high level of original descrete component R and D.

So descrete components **for CATV** became a thing of the past.

The key word was, and is, **volume**. Volume means hundreds of thousands of specialized component parts annually. That is the kind of number TRW saw when they developed the special hybrid chips for CATV plant amplifiers in that era.

Volume separates pricing in a hurry. A person could go into a "job shop" and have a really top-notch state of the art amplifier for CATV constructed today. It would possibly be better than anything today available, it would utilize component parts designed for some other communications application, and it would probably cost several thousand bucks a unit in the relatively small quanity level of say 100 units or so.

The same top-notch state of the art amplifier **designed and constructed** by the custom job shop could **then** be copied (part for part, layout for layout) by **another** small job shop, and it might sell for half a K note a copy. The **difference** in price would be the advantage the smaller job

shop has because of (1) **not** having to spend any time (i.e. dollars) on **original** engineering design, and, (2) having a **lower** general and assignable (G and A) overhead structure. But the unit price of the product produced would not come down to the really quanity (volume) level it was capable of, even at this point. Because even the small job shop would be forced to utilize component parts not designed specifically for the application at hand, and would be paying fairly stiff prices for the parts (a factor caused by the small order volume it produced plus the premium price attached to the parts themselves when they are originally designed for a low volume useage industry).

All of this is a mixed bag of interesting and not so interesting background. It says that CATV failed to live up to its big volume promise, and the people who are in a position to create big cost reductions in CATV equipment lost interest in our tiny industry.

At the same time descrete component part research for specific CATV applications quit, the **same** shortage of volume sales impacted upon the people in **our own** industry who also had a stake in volume sales; the original (CATV) equipment manufacturers. With sales not reaching forecasted levels, certain economies had to be effected. Outside sales forces shrunk, advertising budgets went down, and field service help dried up. Consolidations took place, and the bottom line was still red. So the cuts went deeper. Eventually they reached raw engineering, where new products were being designed and technology changes in existing equipment then in the line was under way. The whole of the industry was geared up for a thunder-buster and it barely sprinkled.

The bread and butter of the cable industry has long been in the **volume** in plant construction. Cable volume produced several head to head, professional, cable manufacturers each of whom actively sought new ways to bring down costs, keep quality up, and provide improved service. Plant volume produced the special-for-CATV components in CATV line amplifiers, which in turn produced semi-automated production facilities. The equipment costs actually came down or stayed static during an era in the early 70's when other business costs rose. It was the volume of plant amplifiers which made it possible for sizeable research and development (R and D) budgets to be generated. **Without** the volume, **without** the stiff competition of head to head capable plant amplifiers, the R and D budgets were cut and in some cases even dropped. It didn't happen overnight but over a period of five years the change was dramatic none the less.

During this period of time while cable development was languishing many other sectors of electronics were doing very well. The attention of many suppliers, once entirely devoted to CATV, shifted. It was a matter of survival. Their base of operations shifted so they were not **so totally dependent** upon the cable industry. Small system supplier, CADCO, once the best known name in the industry for supplying the very small systems with specialized small system equipment, gradually dropped out of sight in cable. CADCO diversified into areas such as CB radio and as President Bill Barnhart notes **"Without that diversity we would have gone under years ago."** Not all of the changes occured in the small operations. Jerrold's transition as an operating segment of General Instruments has been even more dramatic. The era when Jerrold dominated the industry's annual trade show and single handedly picked up the full tab for the annual convention banquet was plainly evolutionary "cycled" at this April's national gathering. Frank G. Hickey, Chairman and Chief Executive Officer said it all recently when he noted **"We have recognized that the Jerrold organization must become more productive and cut fat".**

And so where did all of the new product innovations go? After twenty-five years of dramatic annual changes and a fast moving "state of the art", where did the art go? Had it been lost?

What's happened is purely evolutionary. It is also purely economics. Big companies, absent the volume required to fund extensive R and D, more worried about meeting next week's payrolls and the current month's shipping quotas than **next year's** new product plans shifted gears and emphasis. At the same time two other things were happening. While CATV slowed way down, and the R and D budgets were no longer available to keep CATV technology current with the fast paced changes in all of electronics, small specialty companies began to develop very specialized product lines. Many of these companies were formed by former employees of larger CATV production companies. These smaller companies started out with (as Frank Hickey might note) "the fat gone". They started out with a handful of people, a few concepts, and the background of engineering or management of bigger companies. Mid State Communications, formed by two former employees of Texscan, is an excellent example of the case in point. If you take technology of the big company, set up shop in a small rented facility, and concentrate on a very narrow product range, **you just might make it.** Small companies have several advantages bigger operations don't have. They are small enough to move fast and that's important. New products, developed in a hurry and for minimum invested engineering time and dollars, are a must. Without new products the small company has no chance for survival nor for competing with the bigger outfits. Tom Olson of TOMCO has observed **"The key around here is to have at least one new, totally innovative product every year".** What Olson is saying is that first the small

company seeks out relatively small production item products. Find a market for some box that might sell a couple of hundred units a year. Such a market is often well recognized as for-need-for-product but it is simply too small for most if not all of the larger suppliers to bother getting expensive corporate overhead involved in. **"Around here new equipment engineering is not a function of a small allotment of an annual sales volume; it is a matter of survival"** adds Olson.

So the small, speciality companies such as TOMCO and Mid State have been hard at work devoting unusually large portions of their own internal energies and available dollars to "staying alive" by constantly working on new product innovations. That is one element that has developed over the past few years, at a time when the larger companies have largely abandoned the extensive R and D operations of years ago.

The other element is the peripheral "fall out" of general electronics technology. During the golden era of innovative CATV engineering, say the late 60's and the first couple of years of the 70's **every** new announcement of a **new** transistor or other prime component part by the component manufacturers immediately resulted in an engineering assignment for some budding young engineer in one or more CATV R and D facilities. **"Will it work in CATV?"** was the question always asked. The answer was **usually** "no", but in the process of evaluating the steady stream of new parts the CATV industry **stayed current** with the component "state of the art". Nothing slipped by. Virtually every opportunity was taken to improve CATV's equipment lines.

There are hundreds of new transistors and primary-parts developments **each month.** To check **each** out for CATV applicability takes time and it takes money. R and D money. When this systematic checking process ceased, or was cut way back, CATV innovation **by CATV companies** ground to near a standstill. It created a vacuum. And vacuums like to be filled; it is their nature. If CATV was not doing all that well, and it lost the ability **as a manufacturing industry** to keep up with the state of the art of components, other areas in electronics doing better than CATV began to become interested in the vacuum. Q-BIT is a good example here. A prime supplier of **50 ohm world** small signal amplifiers, Q-BIT noticed astutely that CATV product design was beginning to fall behind the component state of the art. Their "nut" covered by their 50 ohm business, it took less than a major development effort and a major investment for Q-BIT to modify some of its "state of the art" 50 ohm amplifier approaches for the 75 ohm market. In a round about way, Q-BIT's product line for CATV was developed peripherally to their major business concern. The facility was on hand, the engineering already done for small signal amplifiers. The changes required for the 75 ohm world were much less in cost to the company than would have been the case if **another company** started out **from scratch** to develop a **purely 75 ohm** small signal amplifier product line.

So there has developed in CATV a "fall out" atmosphere wherein companies with very little or no previous 75 ohm world product experience have developed **supplemental** product lines **for CATV.** In most cases the 75 ohm products could not and would not have made their way to the marketplace in a pure 75 ohm environment. The costs were simply too great, without the subsidy provided by either the 50 ohm world or by products unrelated to CATV. But as a **supplemental** line of products in a company where the basic overhead was already being paid by **other** product lines in **other industries,** the CATV overhead was minimal. And since, as in Q-BIT's case, the R and D costs were largely already "covered" by the major emphasis of the firm, the CATV product line could afford to be designed and marketed; and of greater importance, the R and D necessary to keep the product line for CATV current and "state of the art" was already in place.

Most CATV people with five or more years under their belts well recall that there was an era in this industry when every piece of equipment, from the off-air-antennas to the matching transformer came from a single supplier. There are many-many "all Jerrold" or "all Ameco" (etc.) plants throughout the country, even today. It **was** unthinkable, from the system operator's point of view, to hybrid or mix his product lines. **It was simply not something one considered.** That era is all but gone. The speciality companies and the "peripheral companies" have seen to that. A Q-BIT pre-amplifier or a TOMCO processor or a Mid State meter are apt to show up most anywhere; even in a turnkey system installed by a large, major supplier. Bill Barnhart of CADCO recalls **"I remember the day when CADCO sold a complete 12 channel headend into a new system in South Carolina. This was a Jerrold turnkey and Jerrold financed plant. But the buyer insisted on CADCO antennas, CADCO pre-amplifiers, CADCO strip processors. We got our purchase order from Jerrold and we got our money from Jerrold. That never would have happened in 1970!**

It all boils down to innovation. When the small companies or the peripheral companies get the technology jump on the larger suppliers, there is a form of buyer revolt. And a technology jump takes raw research and development. If the big boys can't afford it. . .and the small guys are alive **only because** they have it, sooner or later the buying habits begin to change.

There is one more element involved in the "new" technology "base" for CATV; and that is the pure fall out from other industries. Microwave is an excellent example of how this whole arena is perhaps about to create major waves in the CATV 75 ohm world. At the most recent (April) annual industry trade show in

Chicago, a not unkown to CATV company pulled the rug out from under virtually everyone else in the microwave business. And police radars are the root of the innovation.

Microwave has gone through its ups and downs in CATV through the years. By the mid 60's GHz microwave for CATV common carriers was apparently going to be "big" business. And so it attracted the speciality marketing efforts of several big names in microwave gear. Names like Collins, Raytheon, and Motorola. Then as the late 60's rushed across the industry the FCC got heavily into the CATV microwave act and a "freeze" all but stopped the then rapid expansion of CATV microwave in the 6 GHz region. **When the dust settled two things had happened.** The FCC has ruled that future CATV microwave was going to have to be in many cases shifted up into the then-new 12 GHz (CARS band) region. The practical effect of this change gladdened the heart of most over-the-air broadcasters; CATV microwave growth was severely stunted. **So there went the volume** that had attracted the Collins/Raytheon/Motorola crowd. And with the volume disappearing... interest in CATV went by the wayside as well.

With the sharp cut back in CATV 6 GHZ growth, and the newness of the 12 GHz band a new generation of CATV microwave developed. Out of the competitive juices came a couple of new formats for CARS band, and one of those (Hughes' AML approach) eventually became the dominant product. The AML approach was **perhaps** one of the **last really innovative** product designs for CATV, coming as it did at the end of the golden era for CATV R and D. The CARS band equipment development, and more especially the AML gear, came during a period of history when another major innovation was gaining a toehold in electronics. That was (and remains) the revolutionary switch to totally solid state microwave equipment. Had AML gotten started even a few years prior, when klystrons were still the standard approach to getting RF power output at microwave frequencies, the story may well have been markedly different. But AML came along just as solid state microwave transition began, and so it hit the ground running as not only new but with solid state reliability going for it. The volume was sufficient to sustain the necessary R and D at Hughes to bring out such an innovative product; provided the pie didn't get split up too many times. As the AML trade press advertisements reported for many years, AML had **all but** 100 percent of the market. It **was** a strong hold for one company, and while others have chipped away at gaining a toehold in the CARS band marketplace, the relatively small market to begin with plus the head start gained by AML's approach never really provided sufficient volume "potential" for anyone else to sit down and invest the necessary R and D bucks to give AML a race for their money. Again, there needed to be volume to get the R and D work done, and with AML's headstart and basically state of the art package anyhow, the opportunity for competition-**serious competition** just was not there.

But other areas of solid state upper-band(s)-microwave were not sitting still through all of this. The 8/9/10 GHz range was experiencing an explosive growth at government and private levels and many non-CATV-acquainted manufacturers were busy developing microwave products for the non-CATV marketplaces. **Some** of these markets were **very** large. Police radar, operating in the 10 GHz range, was one of those markets. The little 10-50 milliwatt output transmitters and their companion receivers were reaching a highly sophisticated state of the art. Little known to CATV solid state microwave components with strange sounding names like IMPATT diodes and TRAPATT diodes and GUNN diodes were being developed in laboratories at RCA and IBM and elsewhere. Lots of R and D bucks were going into these new approaches to generating transmitter power and receiver sensitivity at the 8 GHz and up ranges. And the markets, both domestic and foreign, were sufficiently large to sustain the R and D costs. A dollar volume revolution of sorts was under way in the microwave region. **Each** new development that brought hardware costs **down** resulted in new applications for the equipment. **This increased the volume** and the circle for **yet new** R and D funds was complete.

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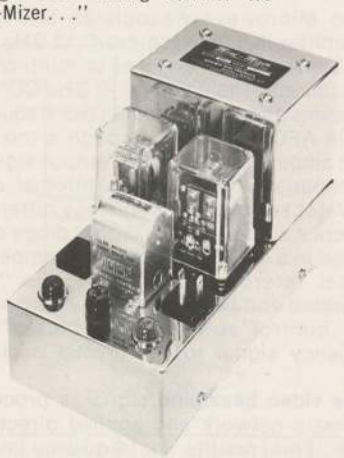
"TV Signal Service first installed the Brown Mini-Mizer in March 1974 at all plant power supply locations where line surges and lightning surges caused unexpected service outages. The Mini-Mizer has cured out outage problems; we no longer reset breakers and change fuses during storms. We recommend the Mini-Mizer. . ."

T. C. Masters
TV Signal Service
Mena, Arkansas



Are you still experiencing plant or headend outages because of uncontrolled power line surges or lightning strikes? For hundreds of CATV systems, this is a problem of the past. There is a full line of Brown Electronics Mini-Mizers (patented circuit) available for all plant and headend application. Call or write for complete information.

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An inkling that perhaps a new pricing era was approaching for 10-12 GHz microwave equipment first became apparent in February when Microwave Associates (Burlington, Massachusetts) announced in a handful of amateur radio publications that they were offering a 20 milliwatt GUNN oscillator **transceiver** (i.e. a 20 milliwatt output RF transmitter **with** a 12 dB noise figure receiver built around a Schottky type mixer diode) in the (amateur) 10 GHz band for (are you ready for this) **$108.00.** The package was considerably sweetened by the Microwave Associates offer to include a 17 dB gain "horn" type antenna for the same price. In fact, the "ham" could buy a **pair** of the transceivers ready to put on the air and communicate in the 10 GHz band for $185.00, including the horn antennas.

Now Microwave Assoicates is what you would call a **large** international company. The number of 10 GHz transceiver units they **might** possibly sell in the limited "ham radio" market could not **possibly** amount to sufficient volume to offset even the supplier's one day postage bill in a full year. The "ham transceivers" were obviously being offered primarily because one or more of the Microwave Associate hierarchy were themselves hams, the company had the product in production **anyhow** for **other** markets, and the "other" market where the small units were being sold was sufficiently large to have already brought the price down to the rather astounding $100.00 per transceiver range.

So it was with no more than moderate surprise that in Chicago in April at the annual trade show the Microwave Associates display booth proudly announced the "October 1977 availability" of a complete 12 GHz CARS band **single** channel, **FM** (frequency modulated) microwave hop **for $2400.00;** less the receive and transmit antennas.

"We are sincerely worried or concerned with

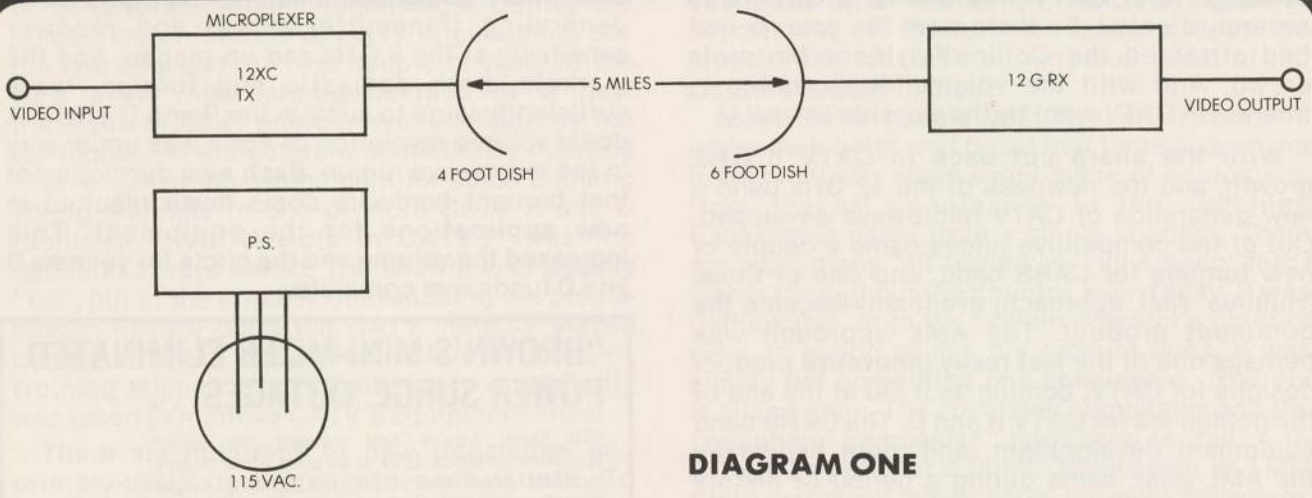


DIAGRAM ONE

MICROWAVE ASSOCIATES LOW COST GEAR

The Microwave Associates MA-12XC CARS band transmitter is a "Microplexer" 12 GHz range transmitter suitable for single channel or multi-channel microwave applications. The unit is a 12 GHz GUNN diode package operating directly at the 12 GHz frequency chosen. The unit is AFC controlled through a mixer cavity where a small amount of the 12 GHz output signal is coupled into a comparison-mode with a internal crystal controlled oscillator source. The frequency difference between the reference signal and the GUNN diode oscillator signal is divided in a digital network and compared directly to the crystal reference oscillator. The "error" signal is integrated and fed back to the microwave (GUNN) diode as a control voltage. This "locks" the microwave frequency signal to the crystal oscillator source; **i.e. AFC.**

The video baseband signal is processed with a pre-emphasis network and applied directly to the (GUNN) diode. This results in frequency modulation of the (GUNN) diode oscillator.

The MA-12XC operates directly from 115 VAC, is housed in a small container (approximately 6 inches by 6 inches by 9 inches). The housing mounts either indoors or at the base of the tower/mast inside of a metal weatherproof container. Each of the MA-12XC "transmitters" comes with suitable transmission line "plumbing" equipment to allow it to either directly feed the waveguide to the antenna or be coupled into a "microplexer" (coupler) network plugging into other channel-packages also connected to the same antenna. Up to 20 channels can be transmitted through a common transmit antenna.

Output power is in the 20 milliwatt range (12.7 to 12.95 GHz). FM deviation is +/- 4 MHz for 1 volt video peak to peak input.

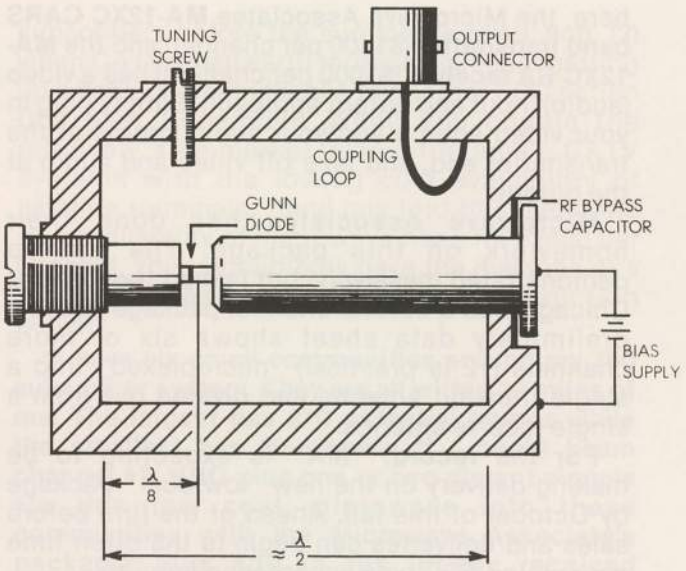
The receiver package is a similar package utilizing a Schottky mixer diode. As shown in diagram 2, multiple channels are fed by a single receive antenna.

Microwave Associates suggests ranges of 5-10 miles utilizing 4 foot transmit parabolas and 6 foot receive parabolas for multiple-channel installations. Communications is limited to line-of-sight paths, with spread (or free space) losses being the primary contributor to path attenuation. At distances of 5 miles the computations indicate fade margins of 35.6 dB with the 4/6 foot antenna installations. At a distance of 10 miles, utilizing 8 foot antennas on both ends of the circuit, computations indicate fade margins of 38.2 dB. Paths as long as 20 miles would seem within reason; a subject CATJ will explore in greater depth as the subject matter "matures".

The manufacturer is Microwave Associates (Inc.), 63 Third Avenue, Burlington, Massachusetts (01803); telephone (617) 272-3100. Pricing on the MA-12XC-T transmitter is approximately $1,400 per channel while pricing on the model MA-12-XC-RA receiver is $1,000 per channel.

this product" explained an engineer for Microwave Associates. **"We are not exactly sure what it is we may have created".** The engineer was speaking perhaps out of turn, but he was reflecting on the question 'Is this not a major price breakthrough in microwave packaging, not merely for CATV, but for a wide number of applications?'

Before you run off looking for a friendly ham radio operator to order up the Microwave Associates $108.00 transceiver package as a cheap and dirty means of getting some signal to squirt across the river or down the road, it should be made painfully **clear** by CATJ that **while** the pricing of the amateur transceiver package is "dirt cheap" there are several sound reasons why this is **not** something **you** can adapt to CATV operation. First of all, **any** microwave equipment put into service by a CATV system **must** by necessity have an FCC license. The FCC license will **only** be granted **if** the equipment which you intend to utilize (and you indicate what type of equipment you intend to use on your microwave or CARS band application) has been type accepted for CARS band use. The Microwave Associates gear that is offered to the hams at the ridiculous $100 price is **not** type accepted for anything. (It does not have to be for amateur use; but for commercial use it **must** be type accepted.) And then there is the matter of frequency. The 10 GHz **amateur** band is **not** the 12 GHz CARS band. True. . .the GUNN diode package **might** be re-mounted into a suitable 12 GHz package and made to function in the 12 GHz band. If you are an engineer and know what it is you are doing. And then you proceeded to get type acceptance for your "one of a kind" adaptation.



Simple Gunn-diode oscillator uses a half-wavelength coaxial cavity. Impedance matching is provided by the output coupling loop. This type of circuit can be tuned over an octave or more, but difficulties with oscillation at harmonic frequencies are common, and the coaxial cavity is more sensitive to temperature changes and load mismatches than waveguide resonators.

DIAGRAM THREE

Then there is the matter of modulating and demodulating the unit. The 10 GHz amateur unit lacks several refinements which the CATV operator would insist upon. The 10 GHz amateur package lacks **a modulator,** and the suggested packaging for amateur useage (see **HAM RADIO magazine,** pages 10-22, April 1977) involves utilizing a 30 MHz i.f. "offset" or adapting an FM broadcast band receiver as an i.f. strip that includes the demodulator function for the receive side of the ledger. As outlined separately

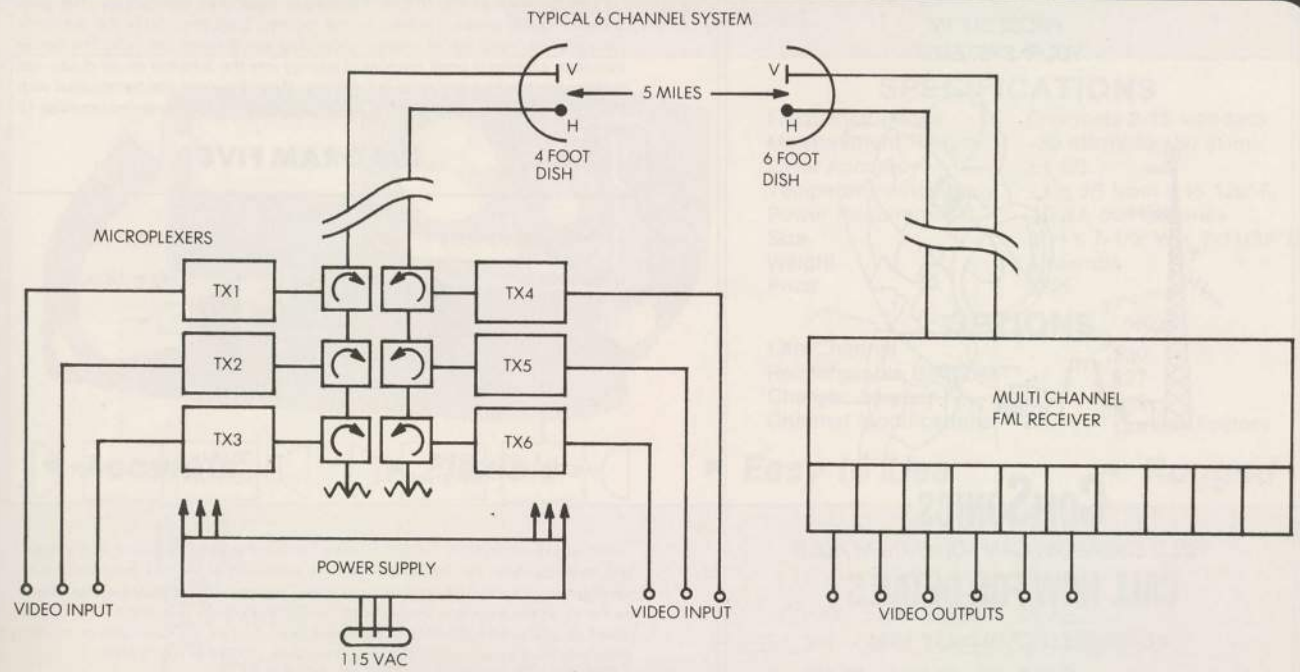


DIAGRAM TWO

here, the Microwave Associates **MA-12XC CARS band transmitter** ($1400 per channel) and the **MA-12XC-RA receiver** ($1000 per channel) has a video (audio) input and output approach. Simply plug in your video source and your audio source at the transmitter end, and take off video and audio at the output.

Microwave Associates has done their homework on this package. The set up demonstrated (passively, but lashed together) at Chicago was a several channel package and the preliminary data sheet shows six or more channels (12 **is** practical) "microplexed" into a single transmit antenna and divided out from a single receive antenna.

For the record, "MA" is expecting to be making delivery on the new "low cost" package by October of this fall. Ahead of the firm before sales and deliveries can begin is the often time consuming FCC type acceptance program.

(Editor's Note: A series of in-depth articles is currently in preparation by the CATJ staff covering the newest approach to low cost microwave service. The first segment, to appear in the June CATJ, will deal with the theory of operation of GUNN diode microwave oscillators. A subsequent report will detail the design of the Microwave Associates package. It is likely that the package will be shown and perhaps demonstrated at CCOS-77 [see separate report this issue] **this summer.)**

CATV MYSTERY

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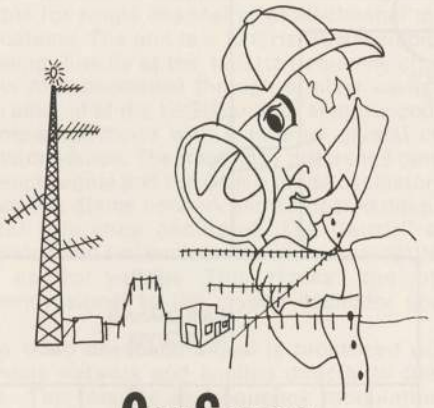

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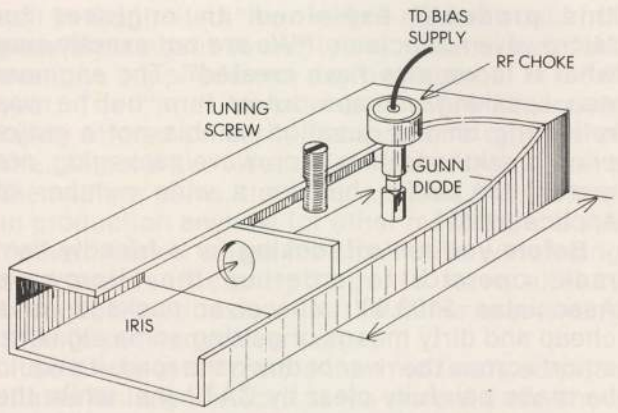
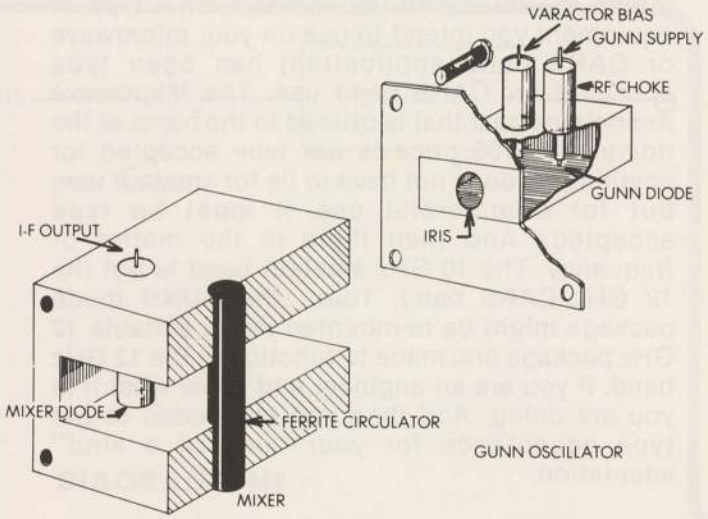


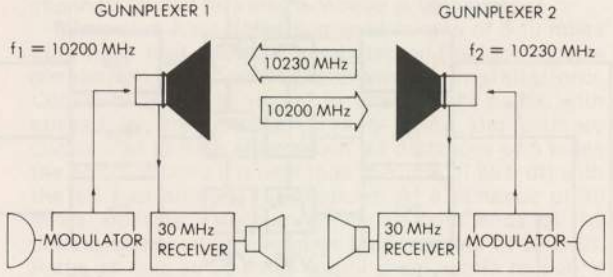
Simple waveguide resonator for Gunn-diode oscillators. In this circuit the microwave energy from the Gunn diode is coupled into the cavity with a post mounted between the narrow dimension of the waveguide. The size of the opening (iris) is optimized for maximum power output and isolation from impedance mismatches. The rf choke requires careful design for minimum rf loss.

DIAGRAM FOUR



Cutaway view of the 10-GHz Microwave Associates Gunnplexer. The post-coupled Gunn diode is tuned to the desired frequency with the dielectric tuning screw, and the rf energy is coupled out through an iris. The ferrite circulator couples a small amount of energy into the Schottky mixer diode and isolates the transmit and receive functions. Mixer injection can be adjusted with the small screw mounted in front of the circulator. A horn antenna provides 17 dB gain.

DIAGRAM FIVE



Gunnplexer operation. Since the same oscillator is used as both a transmitter and local oscillator for the mixer, the i-f at each end of the link must be at the same frequency, and the frequencies of the Gunn oscillators must be separated by the i-f. In the example shown here the Gunnplexer at one end of the link is tuned to 10200 MHz-30-MHz i-f receivers are used so the Gunnplexer at the other end must be tuned 30 MHz higher or lower (10230 or 10170 MHz).

DIAGRAM SIX

Little things, such as an explosion in the size of the police radar marketplace or an explosion in the growth of airborne missile-age electronics systems, **can then** create fall-out explosive growth for other little-connected industries. Such as CATV. And sometimes, such as now, **the timing is perfect.**

Recall that the AML CARS band approach, which to date has opened up CATV for more than 100 communities across the nation, came on the scene at a time when normal CATV microwave was at a virtual standstill; thanks to an FCC freeze. And for AML, the timing was near-perfect simply because the microwave industry **just happened** to be going through a transitionary stage from klystrons to solid state equipment. The combination of an FCC freeze/opening of a new band, plus, the switch over to solid state put AML ahead of the pack. Now along comes **a truly low cost** approach to modest distance CATV microwave (say in the 5-15 mile region in most areas) at a time when **(1)** the FCC has dropped the restrictions on prohibitive regulations for CATV systems of under 500 subscribers (and further promises to make that number 1,000 subscribers before the summer is over), and, **(2)** when CATV **small** earth terminals are just getting up a head of steam thanks to another FCC action this past December. When you couple the relatively free-market place for small CATV systems with the low(er) cost availability of satellite terminals. . .and mix into this blend the new availability of microwave hops for $2400 per channel, you undoubtedly have the makings of a whole new explosion in CATV construction activity.

"I have six small communities around my 700 subscriber system. They are all within 10 miles of me. The largest has 210 potential homes while the smallest has 80 homes. If I could beam channel 17, HBO plus one or two distant signals via this low cost microwave into these communities with the Microwave Associate's package, plus add in the locally received channels on a short 100 foot tower at each **of the smaller communities, I could easily build the complex into 1400 or so subscribers"** noted a very much impressed CATV operator from the northeast at the Microwave Associates booth in Chicago. **"Where do I sign the order form?"**

IN THE JUNE CATJ. . .

Coming in the June CATJ are a pair of additional CARS band microwave features; one detailing the theory of Gunnplexer operation and the second illustrating a clever microwave technique for switching in backup video signals.

Also coming in June is Part II of Steve Richey's "Mini-Freq" (300 MHz) counter, a thorough review of the new Sadelco Digital Signal Level Meter, and some exploration of the new breed of CATV headend heterodyne processor.

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Mid State's LM-13 Signal Level Meter brings you the features of a mid-price instrument at installers equipment prices.

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Power Requirements	10 AA cell batteries
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Price	$225

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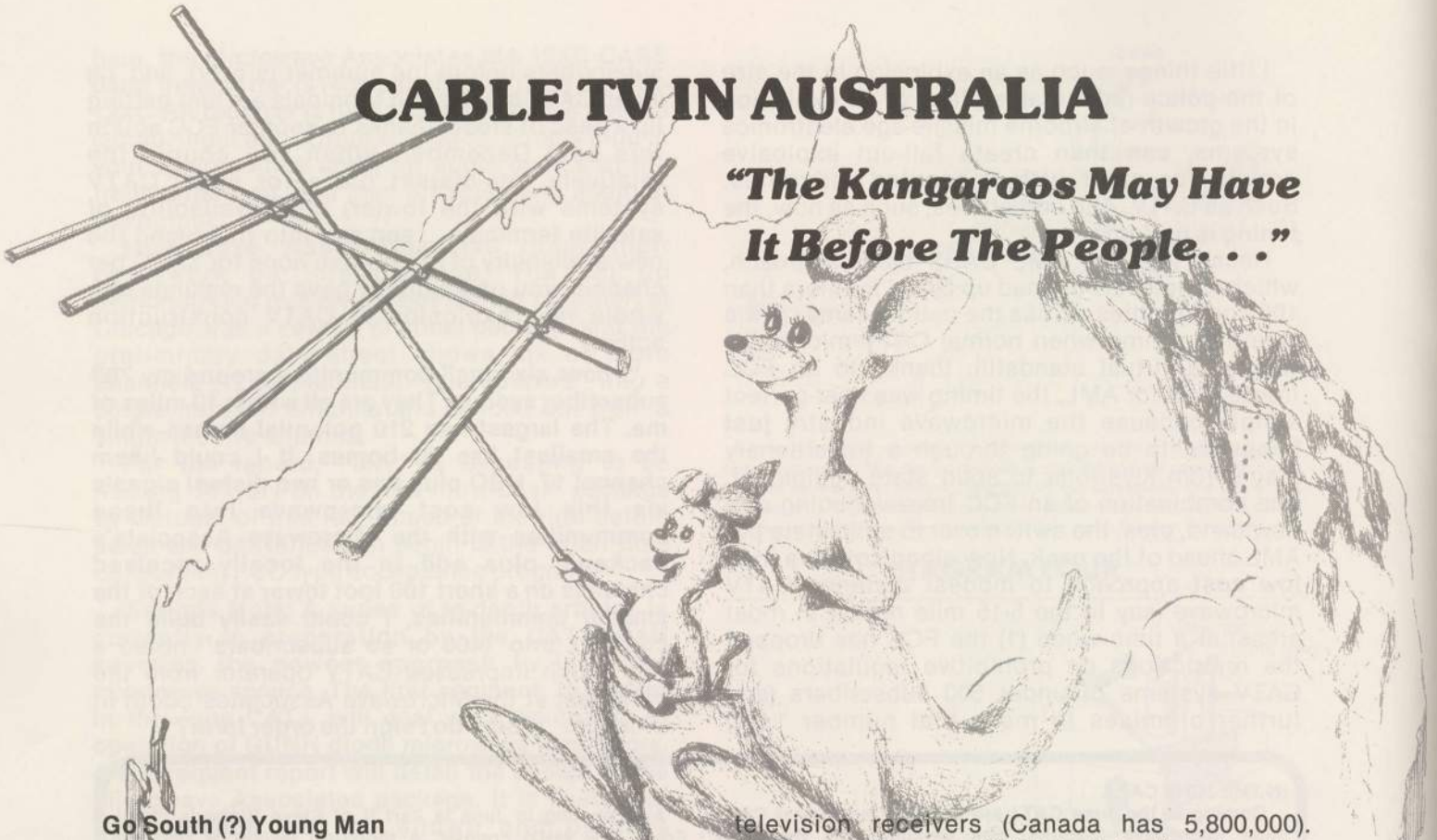


Go South (?) Young Man

When the federal bureaucracy becomes too much for you, and you awake in the middle of the night fretting not about whether your new line extension will attract sufficient customers to pay for itself but rather whether your line extension "meets" the FCC's line extension policies. . .it may be time for you to re-appraise your spot on this earth.

There are others you know. Some have natural attractions not unlike the United States of say thirty or fifty years ago. Rapid growth, a pleasant and diversified climate, a "boom town" atmosphere and the opportunity; the opportunity to do your own thing in your own way, to create your own business holdings in a simple environment of supply and demand, unfettered and unshackled by the make-work policies of bureaucracy.

Australia. Is it such a place? What about the CATV industry there? Is the "climate" conducive to the development of such an industry?

There are comparisons that could be made. The country is almost exactly the same land area as the contiguous 48 states. The population is around 60% of the Canadian population (Canada is about 25% physically larger than Australia), and, like the Canadian population, largely "concentrated" along certain geographic areas (the coast lines on the east, southeast and far west have the most predominent concentrations). The economy, on a comparitive scale of the U.S. and Canada, is relatively similar; but not as advanced.

Television. Australia has television; it has had it since 1956. Australia has just under 4,000,000 television receivers (Canada has 5,800,000). Australia has around 250 television "stations" in operation (112 are characterized as 'low power', which means they are essentially satellites); Canada has around 550 stations in operation (more than half would also be characterized as satellites or 'translators').

Television services. Australia has a policy of 'opening up an area' first with stations owned and operated by the Australina Broadcasting Commission (ABC for short, but not related); Canada has maintained a similar policy with their Canadian Broadcasting Corporation. Both the ABC and the CBC are owned and operated by an arm of their respective federal governments, and are largely (but not exclusively) supported by annual receiver taxes levied on the receivers in use.

Australia has non-government stations as well; although not all areas of the country served by the ABC are within reception range of the "independent" stations. Independent refers to their ownership, not their programming status; a sizeable group of the "indies" have banned together to form the Federation of Australian Commercial Television Stations. In the United States we might call such a group (FACTS for short) a 'network'.

The general concept in Australia is to (1) allow the ABC to put a station on the air, (2) then allow (if the market warrants such an investment) a 'commercial' or independent station to build a station in the same 'market' area. Then if the market is really sizeable, a second or even third 'independent' station is allowed. There are 85 'market regions' with stations licensed; but only 31 of these have two or more stations (meaning

one ABC plus at least one 'commercial' or indie) on the air. This includes the low power stations on both counts. And only a handful of the larger cities have the full compliment of four stations (one ABC plus three indies); and they are Adelaide, Brisbane, Melbourne, and Sydney. Perth, on the far west coast has three stations operating.

Seemingly, if there are three indies in the big cities and 58 'market regions' with but a single (ABC/non-commercial) station, there are at least 58 areas or market regions where a multiple-channel type of service (such as CATV) might go over very well.

Which brings us to the Australian view of economics.

The ABC stations are 'non-commercial' and are, as you will recall, largely if not totally supported out of 'receiver taxes'. The national treasury receives funds from all of the usual sources, plus from receiver owners in the form of a receiver tax.

A recent report issued by the National Communications Planning Branch of the Australian Telecommunications Commission notes:

> **"The development of broadcast television in Australia has aimed at providing most people with access to at least one** (television) **channel,** (normally) **a national** (ABC) **station in areas of lower population. The actual number of channels available at any one place is a reflection of the population of the viewing area; i.e. the size of the market for advertised goods and an equitable allocation of public television funds."**

The **"size of the market"** point is not unlike the arguments advanced in the United States in the late 60's and early 70's; **before** it became so crystal clear that the U.S. (commercial) television stations were hardly suffering with their bank balances. The **"equitable allocation of. . .public funds"** simply means that the national or ABC services goes into an area first because the area is (totally) unserved and secondly after determining that there are sufficient unserved homes to warrant the expense of a new ABC telecasting installation.

If the commercial stations in North America are **not** suffering financially, there is excellent testimony that the same **may not be universially true** in Australia. The first-operating "indies" quickly formed their "federation", or network, and where the government allowed only a single second (or first **commercial**) station into an area, almost without fail these "first-on-the-air" stations joined up with the "federation". With 31 markets with at least one indie or commercial station operating, this produced the first Australian 'network'. When the third station (or second 'indie') came on the air in Adelaide, Brisbane, Melbourne, Perth and Sydney they did what non-affiliated stations all over the world do; they looked for programming, and then had a 'go' at forming a **second** commercial network. Only five stations do not a network make, and it has had its financial difficulties, even if the five stations do serve a sizeable (estimated 70%) of the television homes in the country. The 'failure' or financial difficulties of this five station network received lots of 'press' in Australia, and that served to create an atmosphere that has worked against the development of cable services in the country. The government is even more keen on protecting the economic viability of its licensees than our own FCC, and as long as these five stations could not make a **solid-gold go** of operating **as a network,** any proposal to expand the television viewing choice to the remaining 80 'market regions' went noplace fast. In those four cities with a third 'indie' (or fourth station) the economics of operating without readily available programming has made it tough on the entrepreneurs of the most recent 'commercial' outlets.

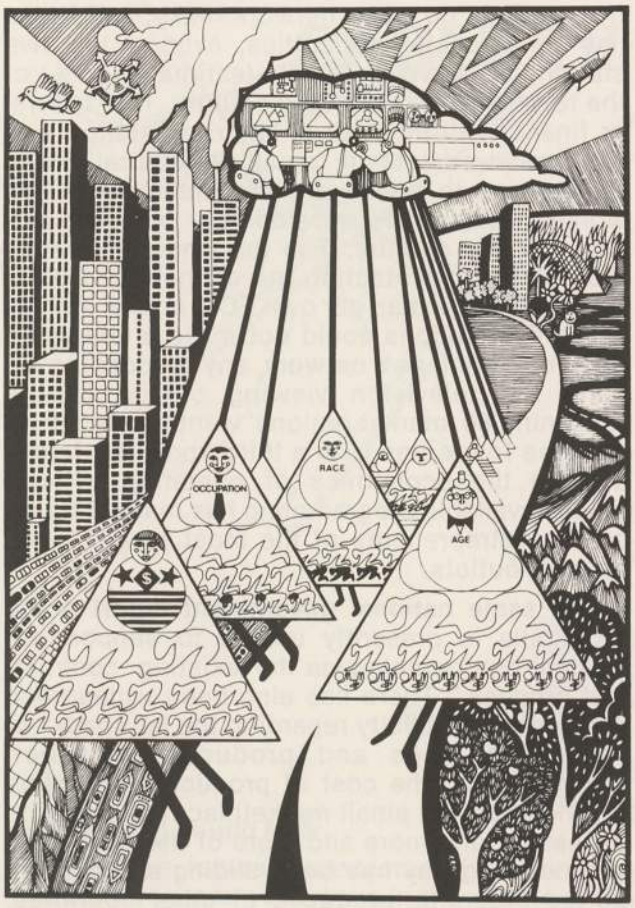
The same national government report notes "Australia is presently unable to support additional programming via the existing commercial process." There has also been widespread news media publicity regarding the "cutback" in Australian made and produced television programming. The cost of producing programs for the relatively small marketplace has become excessive; and more and more of the Australian broadcasting day has been sliding away to imported programs produced in other countries. This has fueled the fires of nationalism creating considerable public outcry that Australian television was becoming less and less Australian in flavor and more and more American, or Canadian, or English or whatever.

All of this has worked **against** the creation of additional programming channels and to the Australians **that is what cable television is all about.** The Australians have also had at least one **other** major problem with cable television as a concept. And that is 'privacy'.

It is difficult to decipher just exactly where the story began, or what it might take to dig out the roots. But it persists and it has played a major role in the stunted growth of the development of CATV in the island continent. In a nutshell, the Australians have a paranoia against 'big brotherism' and they value their own individuality and privacy very highly. The broadband cable concept is a threat to that which they hold near and dear; or at least that is the general **feeling** in high government circles. And those fears are fed on a regular basis by 'feature reports' appearing in generally distributed Australian news papers.

For example, in an official government report issued in December of 1975, in which a very high level government commission attempted to carefully plan the development of the whole of the telecommunications world for the nation through the year 2000, this appears:

> **"There are strong fears in the community that combination of advanced telecommunication**



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services and increasing centralisation (of government) **could lead to a situation where Orwell's '1984' is not merely a literary concept but a reality. Unlimited access to data banks, relentless capacities for behavioural control, and actuarial prediction of group behavior would amount to a form of tyranny which would put to shame Hitler, Big Brother, or any gaggle of South American Colonels".**

Such a statement (re-enforced by several chapters on the same fearful topic, complete with the artwork shown here) would find little acceptance and even less respect in all but the most far-out counter-cultures in the United States. But in Australia, it appears in the official government planning report for all of the telecommunication industries for the balance of this century.

Picking up upon this particular Orwellian theme, in a separate segment of the same official planning report, dealing with the potential for cable services in the nation, there appears the statement:

"There are fears that, because of the bothway transmission capability, cable television could endanger privacy to an extent that it is seen to have the potential of a powerful surveillance and control system such as described in some modern literature".

Getting the cable message across in Australia would appear to present a formidable task; requiring considerable organization, a pretty hefty amount of funding and the patience and time that would be required to change not only the mis-conceptions of what the 'dastardly piece of coaxial cable' was utilized for, but why it could be a useful assistant to the present limited-vision television climate in the nation.

Yet There Is Cable. . .

There is a cable 'industry' in Australia. It is very (very) small, and it operates under handicaps which even the U.S. federal government **plus** the state agencies which now regulate cable in some states **plus** the local municipalities where we now operate have not collectively put into effect.

There are currently eight cable systems in Australia, serving 650 subscribers. The growth of these systems is carefully monitored and at the present time no additional systems are under construction; pending a formal review of the government's cable television 'policies'. The smallest CATV system has 9 subscribers while the largest has 269 subscribers. Several have been installed, after immeasurable red tape, by community developers who found their homes on the wrong side of a hill or mountain; a couple have been apparently installed following North American entrepreneurial approaches (they have the trade name 'Cablevision' or 'Community TV System').

Cable in Australia is regulated under the provisions of a 1942 federal statute, amended as recently as 1975. Among other things, it considers cable television cables in the same breath

as it deals with 'telegraph lines'. Section 130A, for example, allows:

"The Minister may, on the recommendation of the Tribunal (equivalent of FCC) **grant a permit to a person to use a telegraph line for the purpose of transmitting television programs from a receiving aerial maintained and used by that person solely for the reception of television programs to television receivers situated in an area specified in the permit."**

In effect, you go to the Australian version of the FCC to construct a community antenna or cable system. And any system that receives money for the use of a community antenna is considered a regulated system; even if it has but one 'subscriber'.

Then the federal statute places some limits on where the 'specified area' must be located if it is to be considered for a 'permit'. For example:

1) **The cable area** served must be within the 'normal range' of a television station and the area served must be lacking in adequate reception from that station or stations;
2) **The cable service** must demonstrate, going in, that it will provide 'satisfactory reception'.

Or, if the cable area to be served is **outside** of the 'normal range' of one (or more) televison stations (i.e. a fringe area where normal reception is not obtained), then a permit might be considered if:

3) **The cable service** can demonstrate it will provide satisfactory service, **and**,
4) **If the Tribunal** determines that television service in the new region 'is desireable'.

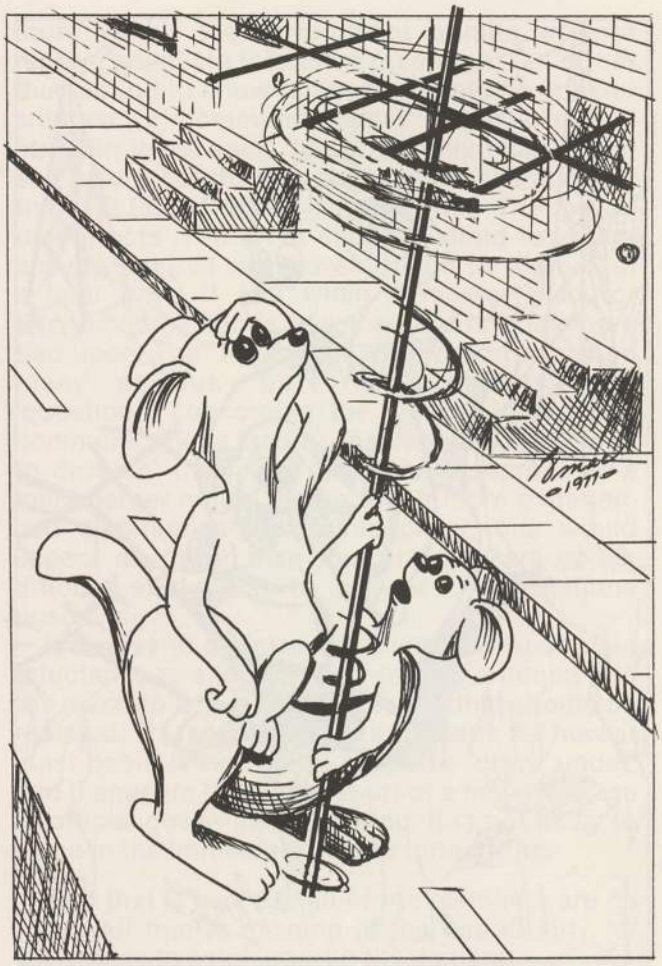
And, if there is 'satisfactory' service already existing in an area, the Tribunal will also look at an application for a permit if:

5) **It is determined** that the station(s) being received in the area do not 'adequately serve the interests of the area', and that via cable programs of greater interest (and service) to the cabled area might correct the situation.

There is one more area where the Tribunal is authorized to accept permits. If the home-region to be served by cable has some form of local zoning wherein outside receiving antennas are not permitted, but the lack of an outside receiving antenna makes television reception impractical or impossible, then the Tribunal will entertain an application for cable service. This applies only if the home-area is within a zone or normal service contour of a television station, and the station(s) to be provided via the proposed cable service are limited to the channels that would be receiveable if adequate outdoor antennas were permitted.

To date, of the eight systems operating, all have been authorized either because of the zoning against outside antennas, or because of irregular terrain in the area blocking direct 'normal zone' reception.

Such permits are granted for five year terms, and 'custom terms' are often included on the permit. Transfer of a permit from one individual/company to another is not possible without official government approval. Fees are charged for the granting of a permit. There are specific limitations on the type of material that can be carried by a cable service; systems are **not** allowed to originate or create any programming of their own, including a limitation of automated channels such as weather and news.



"Community aerial systems are restricted to difficult reception areas within the area served by the station."

Cable systems must have the **written** permission of the broadcasting stations carried, but local permits are not required. All of the regulation is through the federal government.

Resistance To Change. . .

New telecommunication services do not come easily in Australia. For example, the FM radio industry we know in North America is for all practical purposes non-existent in Australia. A handful of experimental VHF (FM) stations have been authorized from time to time to explore the 'wonders' of stereo and sub-carrier operation, but there has been a general reluctance of the government to authorize widespread regular operation of a new aural transmission service.

The same problem has hampered color television. The prestigious report compiled by the government (entitled 'TELECOM 2000') makes the observation that "There are perhaps 40,000

"The position is complicated when some areas have adequate reception from UHF translator stations, resulting in redundant applications. . ."

homes in areas currently receiving poor or no reception, within the normal service contours of existing stations". Then the same report goes on to note that the number of homes so-located, within service contours but not enjoying adequate reception, may turn out to be **far greater** than the 40,000 estimated at this time, "with the advent of colour television in Australia". The tube is still largely black and white down under, and as the cable industry in North America is well aware, the viewer tolerance for picture impairment is far greater with black and white than it is with colo(u)r.

The 'TELECOM 2000' report spends very little time worrying about the improvement of existing (or missing) over-the-air services, and far more time worrying about what "CTV" (their acronym of cable television) **might become if** it is allowed to develop along normal market supply and demand paths. There is the frequent reference to hypothetical situations that **'might'** develop **if** "CTV" was allowed to grow. For example the report notes ". . .the small Australian market for goods and services generates severely limited advertising revenues to finance commercial television. It is **assumed** by the present regulators that these funds must not be spread too thinly in supporting programming, else the quality of Australian broadcast television will be much lower than acceptable. Existing broadcasters **could** claim the CTV provided unfair competition and by attracting viewers from their regular broadcasts, would syphon off advertising revenue. The broadcasters **would then** be forced to lower the quality of the programs they could provide. . ." And, a recently settled U.S. problem is addressed with ". . .the broadcasters **could** claim copyright to their programmes and refuse permission for redistribution over CTV. Copyright. . .is a subject that **will require** considerable **study. . ."**

Still, inspite of the hypothetical 'boogy men' set out in the learned government studies, **there is pressure for improved services.** Apparently the pittance operation of the existing 8 systems has received some coverage and there is pressure on the government to authorize **more** of the same basically 'master antenna systems' in areas within the normal 'service areas' of existing stations. Several dozen such systems are proposed in the Sydney area. The granting of new or additional permits, above the eight now operating, has been frozen for several years while the whole of Australia awaited the prestigious 'TELECOM 2000' report and recommendation. As noted here, the report did nothing to further the immediate prospects of a growing CATV industry in Australia; it raised so many hypothetical questions **(including who should own the cable plant;** this one was left hanging with the recommendation that the government should probably own the facilities) that given ten or twenty years some of the questions might be answered. Under pressure from residents who are receiving poor quality off-air reception, the Minister of the Tribunal has **requested** permission to grant several such additional permits "in relatively restricted pockets of poor reception, pending resolution of policy guidelines by the government on cable television generally". Whether the Minister receives such permission in the current year is one of those 'flip a coin' situations. The most recent annual report of the Australian Government's telecommunications department notes **". . .the position is complicated somewhat by the possibility that some areas may be provided with adequate reception from UHF translator stations, with the result that some applications will become redundant".**

The Australians are just now discovering the 'wonders' of UHF translators, and at least some Australian observers feel that the government would rather do almost anything **except** authorize additional "CTV" systems; including opening up a whole **new** band of television frequencies (UHF is not in use there for television) and forcing the residents in the areas to be served to acquire on their own UHF receiving antennas and converters.

The Australian Situation. . .

Australia is a study in paradoxes. The country experienced an immigration boom in the 50's

and 60's; a boom that has slowed to a trickle in more recent years. The boom was helped along for many years by an official government program that provided considerable financial assistance to 'landed emigrants' who brought to Australia much needed professional skills.

The country is virtually the same land area size as the United States, but it has less population than our California. Huge segments of the country are not capable of supporting concentrated life; other areas, along the east coast in particular, offer some of the best climatic living conditions in the world.

The 'TELECOM 2000' blueprint for the further development of communications in Australia alternately paints **all** of the Orwellian theories of 'dangers' of a 'broadband, two-way, inter-active' communications system; and **then** suggests:

> **"The ability of the average household to pay for services is, of course, an important factor. Average incomes** (in 1974-75) **currently are in the region of $8,000 per employed person** (male and female, averaged) **per year—(suggesting) a descretionary element of sufficient size to permit many households to subscribe to some form of telecommunications service additional to the telephone. . .".**

And then it makes the point that 60% of all Australian households have a telephone. The percentage that already have television is beyond 90%.

The country has no fewer than 40,000 homes currently within range of 'normal' service contours which the government **admits** do **not** receive adequate television reception. But rather than acting to allow relatively simplistic 'master antenna' or 'community aerial' systems to construct in those areas, the government has endorsed a policy of 'further study' under the guise of the 'TELECOM 2000' investigation. The government acts with great caution, afraid to create any system that will prove difficult to 'dig out' at a later date, **if** and **when** a master plan for telecommunications development is finally settled upon. The 'TELECOM 2000' report raises so many serious 'potential problems' and 'questions' concerning the type of 'broadband communications facility' that 'should be allowed to develop' that even given the resources of a much larger nation, and a much more experienced communications bureaucracy, one would expect no fewer than five or ten years of additional study just to answer the questions posed.

It is easy to criticize, from afar, the Australian reluctance to allow cable or master antenna into the marketplace. **It is a temptation that should be resisted.** The bottom line is sufficient; for now at least cable is not going anyplace 'down under' and it appears likely that short of a major change in official government thinking, it is not likely to do so in the immediate or near term future.

And that is sad. For all of the elements are on hand. All that is missing is the opportunity for the supply to catch up with the demand.

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Microwave Path Alignment— Part II

by
John Schuble/William Ellis
Telesis Corporation
Evansville, Indiana
47714

Microwave path engineering includes a number of steps that must be taken to arrive at the desired final result. The dollar conscious cable operator who is willing to expend his own energy can, with proper guidance, undertake certain of these efforts himself and achieve significant monitary savings. One of these efforts is the "field survey". A field survey is just what it sounds like; an outdoor exercise to verify paper path engineering.

Equipment manufacturers are generally willing to supply a significant amount of the path engineering at no cost (except for the purchase of their radio equipment). But they will not and should not be expected to complete a field survey. Although a field survey can be contracted to a qualified microwave engineering company, it is costly, averaging some $1500 for a simple relatively flat terrain path.

Before spending that kind of money for a mere paper report, the prospective microwave user might ask if the field survey is really necessary. The answer to that question is that a field survey is an insurance policy. It insures that the topographic maps were correct and that no new path blocking structures have been constructed since the topo maps were last up dated, (sometimes many years ago).

What is risk-to-premium-ratio of the field survey "insurance"? That figure may be determined by considering the implications of a blocked path. If the transmit or receive tower cannot be increased in height to clear the obstruction, a new transmit site would probably be needed. A new site would involve:

1. New path engineering.
2. **New FAA clearances.**
3. New zoning variance.
4. **New FCC construction permits.**
5. Removal and replacement of tower and buildings.
6. **Restoration of original tower site.**

Faced with these possibilites, the field survey "insurance premium" looks very inexpensive. But in this case there **is** a way to have the "insurance" at a very very small premium. That is by conducting your own field survey. Impossible? No! It's a matter of following some straightforward rules and interpreting the results.

How to Proceed.

First of all obtain topographic maps of the entire path. Maps and indexes can be procured from the "USGS" at the addresses given, and used by any individual to report the necessary data.

For maps East of the

TOOLS OF THE TASK-topographical maps arranged to show complete path, 100 foot tape measure, straight edge, inclinometer and compass.

Mississippi

Eastern Region Map Distribution
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1200 South Eads Street
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For maps West of the Mississippi

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Central Region
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Federal Center, Building 41
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The "Surveyor" uses transparent tape to connect the necessary maps together. The transmit and receive sites are then marked on the maps, and a straight line is drawn connecting the two sites. The surveyor can then use the maps to physically locate himself at all points along the path to investigate possible obstructions or other problems, and to verify the information shown on the preliminary terrain profile (usually supplied by the radio manufacturer). Information which can be derived from the maps includes site co-ordinates, range, township and section (for legal description of land), terrain elevations at time map was published, locations of bodies of water (potential reflective surface), locations of airports, schools, churches and other landmarks, locations of surveying benchmarks, marshland areas, locations of railroads, highways, bridges, cemetaries, telephone and power line towers, radio towers, buried pipelines, as well as many other items of possible interest. Additional information concerning maps and the symbols used is received with each group of maps from the USGS, which is color coded. (Blue for water, pink for urban areas, etc.)

A. **Equipment Needed.**
In addition to topo maps and a suitable vehicle, the surveyor will require a good set of binoculars, a pocket compass, 100' measuring tape, and an inclinometer (see diagram 1). The inclinometer is used primarily to measure the heights of objects from the ground and can be purchased for a few dollars.

The user points the inclinometer into the air at 45° and toward the top of the object to be measured (See diagram 2). If it points above the object, the user moves **closer**. If it points below the object, the user moves **farther away**. When the inclinometer's air bubble in the level is centered, and when at the same time the inclinometer is aimed at the top of the object to be measured, the user has created a right triangle, and he knows that the **distance from the inclinometer to the bottom of the object is equal to the height of the object.** A tape measure is then used to measure the height of the object by measuring the distance on the ground from the inclinometer to the

INCLINOMETER

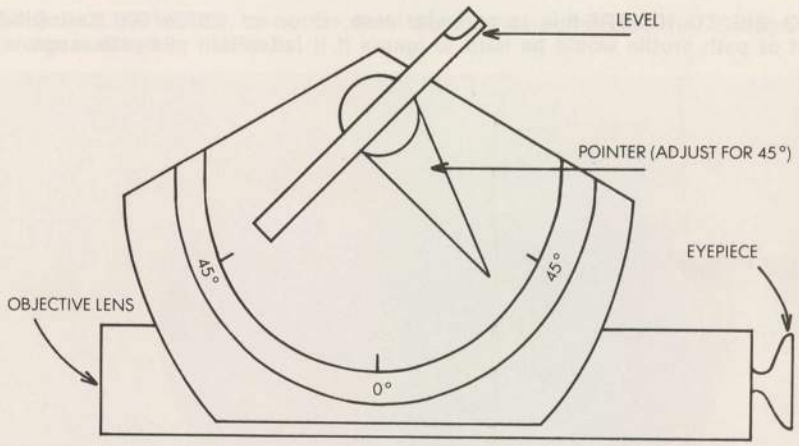

DIAGRAM 1

MEASURING THE HEIGHT OF AN OBJECT WITH AN INCLINOMETER

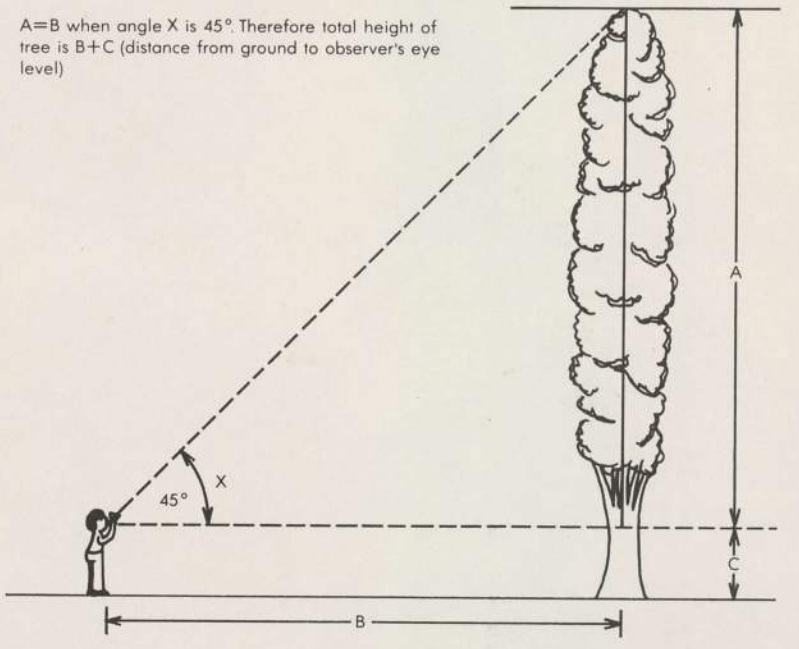

DIAGRAM 2

bottom of the object. (NOTE: The **height of the user** must be **added to** the **height of the object,** since the inclinometer is actually at eye level, rather than ground level.)

B. **What to check.**
In addition to reporting height and nature of obstructions in a proposed microwave path, the surveyor should, as a minimum, include the following items:

1. **Are tower sites marked correctly on the topo maps?** (This data must be used to eventually verify that the preliminary profile was prepared using the proper site co-ordinates.)
2. **Are there any obstructions** along the path which are greater in height than the tree heights drawn on the preliminary terrain profile?
   a. Are there any obstructions to the side of the path **within 500'?** (The actual clearance requirements for the sides of the path are as in the path; however, the 500' number provides some tolerance for the map and user. If nothing is reported within 500', adequate clearance exists for CARS band paths of up to 35 miles. If an object is reported to be within 500' of the path, an engineer and professional surveyor should be employed to determine the exact clearance requirement and to make precise measurements of the object in question.)
3. **If the site** has an existing building, is there room for the microwave racks, batteries, chargers, etc?
4. Report condition and type of tower(s) if existing, as well as available vertical space on the tower for locating microwave antennas. Also report other antennas on the tower which might block or impair the signal of a **"periscope"** shot (reflector).
5. Are there any known **high power radar sites** anywhere in the vicinity?
6. Is there **any other** microwave operating **in the CARS band** of 12.7 to 12.95 GHz? This will often be either Cable TV microwave or television stations' studio to transmitter microwave in the area. Most sites can be eliminated as suspected users of CARS band microwave by checking the **physical size** of the **waveguide** from outside the building, making it unnecessary to contact the owner and/or gain access to the building. An **alternative** to physically checking for CARS microwave is to employ the services of a company with computerized records of all licensed microwave sites.
7. Are there any **flat surfaces** to the **side** of the path whose angle would result in a **second signal being received** via a reflection from this surface? Round water tower surfaces, unless they are unusually

TOO BIG TO IGNORE-this large water tank, if on or within 500 horizontal feet of path profile would be hard to ignore if it fell within mid-path range.

large, may be ignored. Tall gas station signs can be a problem, particularly if they are continuously rotating.

8. Are there suitable roads existing to the sites, which will allow access to the sites during **all seasons** and during inclement weather?
9. Report the distance to the nearest commercial power lines.
10. Does the site present an obvious **zoning** difficulty? For example, is it in an exclusive residential area, or an area where individuals could be expected to strongly object to the construction?
11. If the site is to be used as a CATV headend pick-up point, report the location and power of FM transmitters, and potential sources of electrical interference. **If** the site is to be used **solely for** CARS band microwave, FM transmitters and other broadcast transmitters, as well as sources of electrical interference such as commercial power lines, **may be** ignored.
12. Report bodies of water on or near path.
13. Report the general condition of the tower site(s). For example, is the site heavily wooded, making construction difficult and/or more expensive than normal?
14. Does the geology of the site present an obvious problem? For example, is the terrain rocky, requiring dynamite for anchor holes, tower base, etc. (This **can** present a **grounding** problem also, if rods can't be driven into the ground.)
15. Report any other item specifically requested by the engineer in charge.

C. **Some additional points of interest.**

1. It is tempting to bypass the field survey by **"flashing the path". One end** of the path **emits** a light source of considerable intensity, while an observer at the **opposite end** of the path reports that he can **see** the light. This is **an inconclusive means** of determining path clearance and should **not** be employed, since it makes no allowance for beam bending or fresnel zone clearance requirements. Flashing the path will obviously not reveal many of the potential hazards listed under "what to check".
2. Trees are to be considered **total** obstructions. The engineer may want to make an allowance for **future growth** of the trees.
3. Often CARS band microwave reflectors are located on CATV towers where a considerable number of TV and other antennas are located. The antenna conglomerate is **not necessarily** an obstruction for a proposed periscope shot. The authors have transmitted **thru** antenna groups which "blocked" up to 35% of the reflector sacrificing a signal loss of approximately 4dB with no

USING INCLINOMETER, co-author John Schuble demonstrates the 45 degree exercise outlined in the text.

serious degredation in picture quality.

The field survey is not difficult. Substantial sums of money can be saved by those individuals willing to spend a short time investigating what is required to perform a useable field survey. More often than not, they will find themselves capable of this relatively simple, but potentially expensive, aspect of a quality microwave installation.

LAY OUT THE PATH and then using the check list here spot-in any obstructions or path irregularities as they are spotted and verified.

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EXPANDING THE USEFUL RANGE OF A VSM-2 WITH A PLUG-IN DOWN CONVERTER

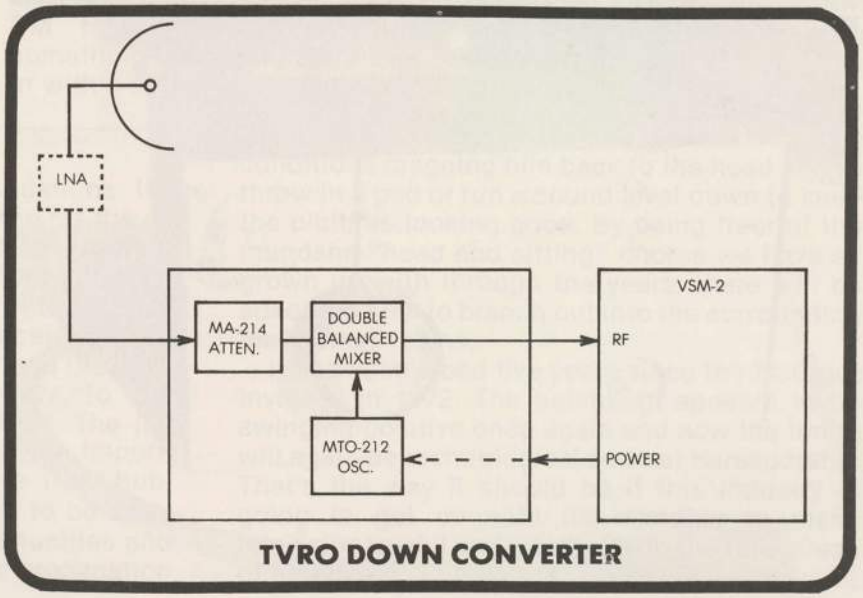
Quick Fix To TVRO's

While the CATJ "crew" was busy inspecting the Afton, Oklahoma test installation of USTC's first TVRO terminal **(see CATJ for February)** and we watched the mechanical effort being put forth to zero in the six meter USTC terminal on first one bird and then another, we were struck by the fact that here were a half dozen people going to a whale of alot of work just to make **sure** the dish was pointed at the **right space** in the sky where **maximum** received signal strength was concentrated. We were also reminded of the CCOS-76 4.5 meter installations and the on-hand availability of a fine (but **costly**) H-P spectrum analyzer that **directly-tuned** the 4 GHz downlink range. So we eyed our 0-1000 MHz Texscan VSM-2 analyzer and thought out loud "It sure would be nice, while you guys are chasing signals and peak signal voltages, to have an analyzer to see what you were doing and how much better or worse you were making the system play!"

Of course not everyone can afford an H-P analyzer machine. Not even all of the TVRO installation firms scurrying about the countryside these days has one in their bag of tricks. But a very large number of CATV systems, especially those who will probably be looking at TVRO's, have a VSM-2 or model -equal around and about. The problem, simply put, is how do you expand the frequency coverage of the VSM-2 to make it play in the 3.7 to 4.2 GHz range? Going inside of the VSM-2 seemed like a purely dumb thing to do; why tear up a perfectly good machine? Especially when all that one really needed is a frequency translation device, or in the jargon of the industry, "a converter".

So we put our heads together with the slide rule of Texscan's Raleigh Stelle and what you see here is the result; proto-type number one of a product that (1) Texscan **could** well be talked into building **if** there is sufficient interest out there, or, (2) a box **you could build** up yourself using a handful of readily available Texscan-type modules that are now off-shelf items. It is, friends in TVRO land, a 3.7 to 4.2 GHz down converter. It gets you 3.7 to 4.2 GHz band signals down in the UHF-TV range where you can tune them in on your faithful VSM-2 machine.

The layout is shown here in photographic and box-diagram form. The modules are either available from Texscan or other sources if you want to do some cross referencing on your own. What we have is a way to plug the down-converter external box into the bottom of your TVRO downline (either direct



TVRO DOWN CONVERTER

or through a multiple-port coupler), and then plug the down converter into the **(1)** battery charge input receptacle of the VSM-2 (that "steals" power for the down converter out of the VSM-2) and **(2)** the RF input jack on the VSM-2. The 3.7-4.2 GHz TVRO signals go through a Texscan MA-214 10 dB step (rotary) attenuator and into a Vari-L Company DBM-601 double balanced mixer. The mixer LO input port is driven with a Texscan MTO-212 oscillator at 3.7 GHz. The "IF" output then comes out of the BNC connector on the back of the down converter and drives the RF input on the VSM-2.

With the down converter box in hand and the VSM-2 in tow the package was taken back to Afton (Oklahoma) where it was field-tested on the USTC installation. We found that we had around 10 dB conversion loss through the down converter; signals were **typically** 30-35 dB out of the VSM-2 analyzer noise. This works this way because of the i.f. bandwidth of the machine and the relatively good grade of LNA on the terminal at the time.

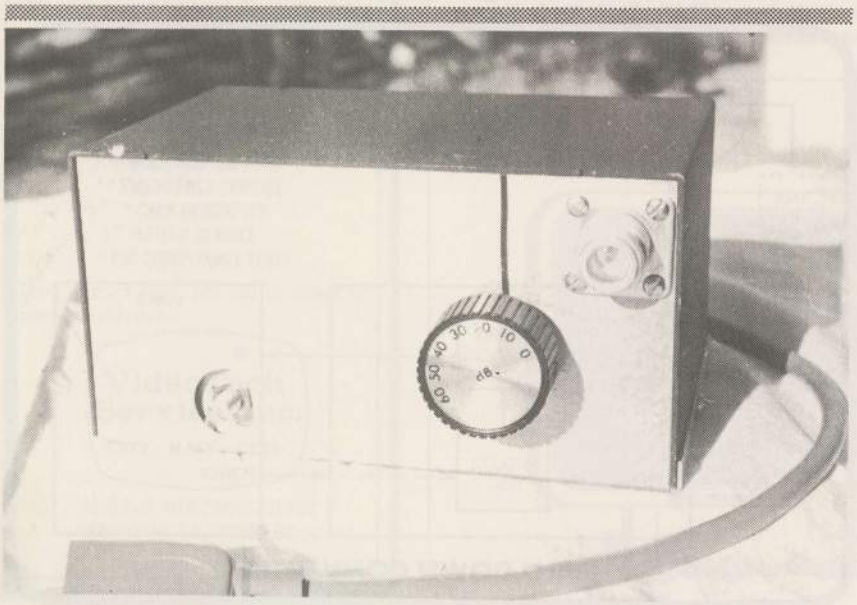
The practical uses of the package are many. For example, you can see **all** of the TVRO carriers coming back at a time, and we found a couple of interesting "unlisted" carriers floating around. In one instance, with the converter and VSM-2 package we found a CW carrier around 20 dB down from a TVRO video carrier that was causing a herringbone beat in the video picture. We had been unsure up to that point what it was that was causing the weak beat. It can be frustrating in the TVRO business not knowing where you are or where the interference might be creeping in. In this particular instance with the analyzer it shortly became evident that the carrier on hand was actually coming back **through** the bird. Somebody was near the middle of the video carrier range for transponder six at the time with an uplink signal **(*)**.

Because you can "read" carrier changes with much better resolution with the analyzer package than you can with the typical TVRO receiver meter, the analyzer gives you a better handle on pinpoint focusing of the TVRO antenna. We also found that we could observe some interesting (if not explained) level changes in one TVRO downlink transmitter at a time with the analyzer. Again, it can be frustrating not knowing whether the gradual (or sudden) appearance of noise garbage in your TVRO picture is the result of something on your end, something at the satellite or something in between. By being able to watch carrier to noise levels on **all** transponders **at once** with the analyzer, it is just like monitoring line levels on a cable system with a multiple channel plant.

Another handy use for the package is the ability to "grade" LNA devices across **all** of the transponder channels active at the moment. Some of the newer LNA units are bandwidth sensitive; they have peaked performance on one segment of the band. With the analyzer you can see simultaneously carrier to noise ratios on say channels 6 and 24 at one time, as you compare one LNA against another one.

What about markers you might be asking. Well, it turns out that the LO in the analyzer, via a multiple or harmonic mode, is going to beat with the LO in the down converter. That gives you several fat markers in the i.f. range and with the assistance of the tuning shaft

***—We've had a couple of reports on some "interlopers" using SATCOM-I for a "relay". Although we've not seen the signals ourselves, several usually reliable sources report that "somebody" is going up to SATCOM-1 around 5900 MHz, passing through the bird and just a "hair" below 3.7 GHz coming back down to ground on sort of a free-ride. We recall the 60's craze of "telephone freaks" who discovered ways of defeating Ma Bell's toll line security system and wonder, aloud as it were, if the "challenge" of a "open repeater in the sky" sitting up there in geo-sync orbit is more than some electronic tinkering types can resist. One particularily well informed source detailed the kind of equipment being utilized** (a couple of watts of RF and some six foot surplus dishes), **the modulation format** (FM) **and the location of the individuals playing this new satellite game** (New Jersey to California was one path mentioned). **We point out that the 5.65 to 5.925 GHz band is an amateur radio allocation** (shared admittedly). **That means that 25 MHz** (5900 to 5925 MHz) **of the normal input passband for SATCOM-I is within a ham band, and if somebody** (properly licensed as an amateur of course) **were to happen to direct some dBm's off say at a point over the equator, he just might find the same signal coming back to him on say 3.7 GHz or just a shade below. Bandpass filters being what they are at 5.9 and 3.7 GHz, it is entirely possible that the low end input cut-off on the SATCOM-I is not sharp at 5.9 GHz and it is just as possible that the low end output cut-off at 3.7 GHz is also not very sharp.** Napoleon Solo, open channel D!

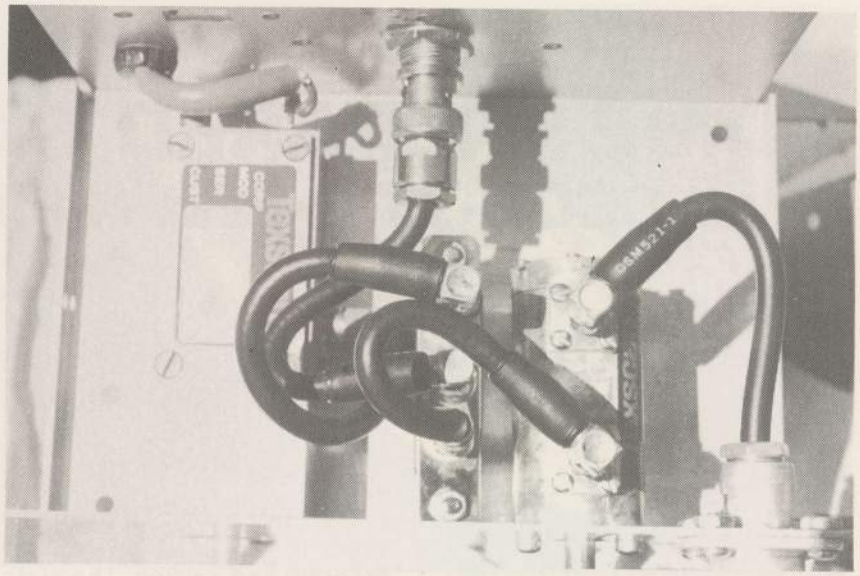


shown on the front panel you can "net" the two "pips" together and read frequency points almost as well as you can with the analyzer functioning in the VHF mode.

Texscan needs a little prodding from TVRO users to put this box into production. Or, inventive types with a few hours on their hands might want to assemble their own down converter using Texscan or other modules readily available.

Having gotten a down converter together and operating, and bringing the 3.7-4.2 GHz TVRO range down to a more understandable VHF/UHF region, somebody out there is bound to ask why you couldn't simply use the down converter as a "cheap and dirty" way of getting the microwave down link range into a (say) 70 MHz wideband i.f. strip; from whence you could amplify and then demodulate to video and subcarrier audio. **Somebody else,** who just got on board, is going to ask why you couldn't use the down converter as a means of putting the TVRO signal into the UHF TV range where you would tune it in with a standard TV set.

The first guy has a point worth exploring. The second fellow needs to be **reminded** that the TVRO downlink signals are FM video modulated with a wide deviation of approximately 36 MHz; plus the audio is piggy-backed on a nonstandard sub-carrier. But then **if** you devised an "FM to AM" converter to follow a suitable i.f., you just might be able to come out of the i.f. through the FM to AM package with something that **could** be tuned in with a standard TV receiver.



It turns out that some Japanese engineers have developed such an FM to AM package (nearly four years ago) and we are looking into it at this time.

Continued from Pg. 5

smaller communities. In such situations the relatively nearby signals will be taken off the air at each community, perhaps with relatively short and certainly inexpensive 100-150 foot "sticks". The harder to get and more expensive to produce "distant channels" will be received and processed only at the "central hub" and then will be relayed via low cost microwave to the surrounding **really small** communities. The improved breed of processors will play an important part, because they will insure the "hub-system" operator that he can afford to be away tending to one of the outlying communities and not worry about some change in propagation conditions dragging him back to the head end to throw in a pad or run a sound level down to keep the pictures looking good. By being freer of the mundane "head end sitting" chores we have all grown up with through the years, there will be adequate time to branch out into the surrounding **really small** towns.

It has been a bad five years since the FCC got involved in 1972. The pendulum appears to be swinging positive once again and now the limits will again be technological and not bureaucratic. That's the way it should be if this industry is going to get on with its mandate to make television useful and watchable in the rural areas of America.

COME PREPARED TO LEARN. . .
CCOS-77 Is Fast Approaching

The dates are July 17 through July 20th. The location is Fountain Head (state) Lodge, in eastern Oklahoma. Fountain Head lodge is located on Eufaula (pronounced you-fall-laa) reservoir some 60 miles south-southeast of Tulsa; just southwest of the junction of U.S. 40 and Oklahoma state highway 69 in McIntosh County.

CCOS-77 is the second 'annual' gathering of the clan, sponsored by the Community Antenna Television Association (CATA). The first such shindig, held at a similar (Oklahoma) state lodge in 1976 was a sell out and there is every indication that the 1977 "gathering" will repeat.

CCOS (for CATA Cable Operators Seminar) is a unique type of gathering. It has all of the elements of a national convention, scaled down to the program and lodging needs of CATV owner/operators and technical personnel. The relatively 'remote' rural setting is a key ingredient to the CCOS concept primarily because it allows relatively inexpensive lodging rates and relatively low cost food rates for extended stays of 4 days or more, in a setting that is **purposefully quiet** and away from the hustle and bustle of larger metropolitan meetings. This 'atmosphere' bids well for the theme of CCOS gatherings; that theme being a series of one-half to full day 'seminar' type sessions dealing with the **practical side** of CATV system ownership, management, engineering and operation.

CCOS is also a family type of program and setting. The state-lodge housing approach affords the ideal location for a cable-person to bring the family. With virtually unlimited outdoor recreation opportunities, covering the range from water sports to horse back riding, golf and tennis, boating and hiking, CCOS makes it possible for a cable operator to combine a family vacation outing with his own wants and needs to stay informed and instructed in the latest technology of our industry.

CCOS is on purpose a 'small' gathering. The total turn-out in 1976 was around 450 people, including wives, children and supplier personnel. The 1977 gathering, at a slightly larger state lodge, will make it possible for an additional 50 or so people to be a part of the 'CCOS Experience'.

Equal Suppliers

The 1976 approach to CATA Associate Member (supplier) participation was to simply set aside a display or exhibit hall area, and divide the available space equally among 42 suppliers. This resulted in each display area having the exact same 'space' as all others; a ten foot display table. Most of the primary suppliers to the industry were on hand, often sending engineering and technical personnel to CCOS because the wise supplier correctly assumed that people on hand from cable systems were by in large operating personnel with direct hands-on responsibilities in CATV system operation.

The supplier participation is not limited to the display area; key engineer and systems personnel from approximately a dozen supply houses were also involved in the preparation and operation of the technical portions of the CCOS 'seminar' programs as well.

The same approach, with approximately the same number of supplier displays is being followed in 1977.

CCOS-77 Emphasis

Emphasis in 1977 is coming in several areas.

The on-going technology explosion in small earth terminals first introduced to the CATV industry at CCOS-76 (where two small or 4.5 meter terminals were in operation; the first such operation in the industry) will continue. Indications are that no fewer than four such 'small' TVRO terminals will be installed **and operating** at CCOS-77, ranging in size from 4.5 meters in diameter to 6 meters in diameter. A **pair** of seminar sessions will deal with TVRO experiences to date (including a session on TVRO operational problems) and the 'software connection' aspects of TVRO programming sources.

The second area of 'emphasis' will be CATV system **microwave**. There is a 'revolution' going on in low-cost microwave. It has occured very suddenly (see separate

report in this issue of **CATJ**) and the long term 'depth' of this revolution is difficult to forecast accurately at this time. Suffice to note that the cost of microwave 'packages' is coming down in one big hurry, and there are bound to be some very innovative and very-low-cost microwave packages available for short haul applications (say up to 20 miles in length) appearing on the market and in CATV systems across the United States in the coming year. In anticipation of this microwave hardware 'revolution' **CATJ** has been running expanded microwave application data in the past few issues, and will continue to do so in the coming issues. The CCOS-77 program reflects this new interest in microwave applications for CATV. A special half-day seminar on microwave system design (planning) and maintenance, conducted by **William Ellis** and **John Schuble** of **Telesis Corporation** is part of the CCOS seminar schedule. Another microwave seminar conducted by **Jim Hurd** of **Farinon** will deal with microwave reliability, getting the best microwave performance for medium and long haul systems. Yet a third microwave seminar, demonstrating several new types of low cost CATV microwave in an operating environment will also be on the seminar schedule.

The third 'emphasis area' in 1977 is the subject of **really** low cost, rural CATV system design and operation. Arizona rural-system-pioneer **Oliver W. Swan** (see **CATJ** for March, 1977) is heading up a seminar task force in this area which will spend two half-day sessions going into how a system can be constructed following state of the art construction techniques in areas with as few as ten subscribers per mile. Swan, and CATJ's contributing editor **Steve Richey,** will cover all aspects of low-cost system construction including providing detailed plans and on-site assistance for those who might wish to construct their own line amplifiers, head-end processing equipment and other component modules for a small, rural system.

4.5 METER TVRO TERMINAL was first shown in operating mode at CCOS-76; two terminals were functioning, this one from Prodelin and a second from Andrew. Four terminals are in prospect for CCOS-77!

SPREAD OUT SOME EQUIPMENT in a designated area, bring in some technically sharp people and schedule it open for evenings. And call it the 'Lab Room'. It was a big hit at CCOS-76 and it will be expanded for more hours and more room in 1977.

At CCOS-76 we tried an experiment which we called 'The Lab Room'. In this concept we set aside a special room which was equipped with CATV test equipment loaned to CCOS by test equipment suppliers such as Wavetek, Texscan, Mid State Communications and others. CCOS attendees brought with them sick or ailing headend processing equipment, pre-amplifiers, traps, CATV plant and a host of other equipment. The 'Lab Room' was open three evenings during CCOS and on an informal basis cable personnel could drop into the Lab Room from after dinner until the Lab Room closed (this was 3 AM one morning) and get expert instruction on equipment maintenance, alignment, and repair.

This proved to be such a successful program that the Lab Room concept is being repeated, on an enlarged basis. With the assistance of **Hansel Mead** of **Q-BIT**, Steve Richey and others, the Lab Room will again be open for anyone who wants to either get expert instruction on equipment maintenance or repair. The Lab Room will also have a special area set aside for construction of low-cost CATV gear, and under the watchful eye of Oliver Swan CATV people can sit down (with parts that Swan will have on hand) **and build up** a proto-type line amplifier, or single channel strip-type amplifier or pre-amplifier, and so on. This Lab Room activity will be operating the evenings of July 17, 18, 19 and 20 this year.

In the same vein, **TOMCO's Tom Olson** will hold a half day seminar on head end equipment processing alignment, in a 'lab type environment', during one of the day-time sessions. Olson is putting together a group of industry head end experts who will be available in this particular session to give specific advice about various types of head end pieces. The seminar will have operating test stations, and any cable person who has one or more 'sick' or 'ailing' head end processor pieces can get first hand expert advice on putting the unit back into shape again at this seminar session. This will be a **'hands-on'** seminar session, with **individual** instruction.

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Kits Again

Another innovation at CCOS-76 was the sit-down session where 24 attendees took CCOS-provided bags of parts and sat down under the watchful eye of Gill Cable's **Jerry Laufer** and constructed the **'Laufer/CATJ Low Cost Analyzer'.** Since that CCOS session, an additional 200-plus CATJ provided parts kits have been ordered by members of the industry and the low cost analyzer seems more popular than ever. Therefore another half day session is scheduled during which CCOS-77 attendees may **either** (1) **construct** from a parts kit the low cost analyzer, or (2) **go on** to a more advanced analyzer construction project involving a newly developed improved i.f. system. Those who **already have** one of the low cost analyzers built up from parts kits supplied by CATJ are well advised to **bring** their operating unit **with them** to CCOS-77 if they are interested in retrofitting the present unit with a much improved i.f. system.

Another Kit-building course being seriously considered is a 300 MHz (plus) frequency counter. A description of the Steve Richey developed counter appeared in the April **CATJ** (see page 31, April 1977) and this counter will be offered as a 'kit building course' as part of CCOS-77 **if** sufficient interest is shown in the interim period.

And Much More

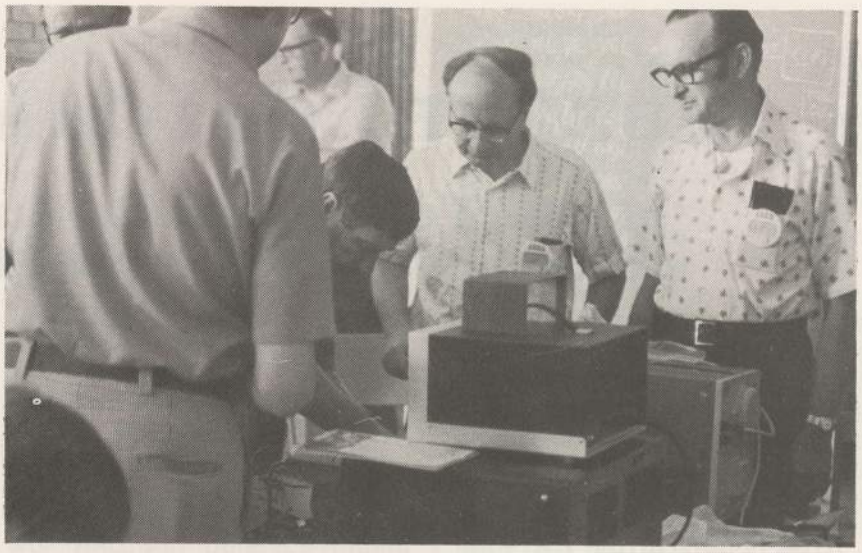
Antennas were big at CCOS-76 and they promise to be even bigger at CCOS-77. In fact, in terms of physical size, it is hard to get much bigger than the 47.5 foot boom 'Logi' described on page 26 for March (**CATJ**)! Last year's outdoor half day session on antenna system design (gain, match, phasing and stacking) was a

standing-room-only program. The same program will be updated this year by seminar lecturer **Tony Bickel** (of **U.S. Tower Company**), ably assisted by Arizona's Oliver Swan (of **Swan Antenna Company**). There may even be a third party on that portion of the program, demonstrating a UHF LaPorte Rhombic constructed from plans set out in the October (1976) issue of **CATJ**.

The CCOS-77 schedule will be a very busy three-plus days for the attendees. The facilities are bigger and newer than 1976, and all of the participants (including the suppliers) are being housed in the single convention facility at Fountain Head Lodge. The Tuesday evening (July 19th) bar-b-que will be repeated, with an interesting 'twist'. This year, immediately following the banquet, the **'CCOS-Family-Hour-Stage-Show'** will be staged. All of the "talent" is being drawn from the cable industry, and the host is CATA's fourth district **Director Ralph Haimowitz** of Sebastian, Florida. Music, dancing, magic and a 'big finish' are promised by Haimowitz. Director Haimowitz, incidentially, is a rather accomplished magician and it is **rumored** that he **may** even attempt the on-stage disappearance of a willing volunteer, right there before your very eyes.

Speaking of disappearing, the accomodations were nearly full as this report was prepared late in April. The registration card found opposite page 9 in this issue of **CATJ** will get you on the list **IF** there is any room left. All housing accomodations are being handled directly by CATA; do **not** attempt to make your own reservations through the lodge facility as the full facility has been reserved for CCOS.

It promises to be an even better gathering than 1976; **hope to see you there!**



HANDS ON ALL THE WAY was the theme of CCOS-76; an approach being repeated in CCOS-77.

TEST EQUIPMENT CONSTRUCTION was highly popular seminar 'course'; shown here are some of the participants in 'Low Cost Analyzer' construction session, during final check out of seminar-constructed analyzer unit.

ALL WORK AND NO PLAY makes the cable operator glad he came! At CCOS-77 bar-b-que an Oklahoma-style outdoor feast will be served, and the cable industry's own finest will entertain at a stage show.

MORE THAN 12 CHANNELS?

Maybe You Should Re-Build Your Amplifiers—Not Your Plant!

The history of the CATV industry has been largely been of throwing out the old and bringing in the new. Tube type equipment has all but disappeared in **most** systems; replaced by transistors. Single channel yagis, while still manufactured and sold for maximum-gain applications, have given away to multi-channel logs. Flexible cable has been replaced where practical by solid sheathed cable.

Progress is like that; it leaves a swirl of dust behind and new hope and promise ahead. But sometimes in the rush to be progressive a person or firm or industry overlooks the practical aspects of bringing the old up to date; or not simply throwing out the old, but settling for modernizing the old. Such is the case in at least one major-dollar area in cable system plan investment; the trunk and feeder line amplifier.

First there was tube gear; single channel, low band only. Then there was "broadband" low-band gear, covering channels 2-6 in one amplifier; FM or part of it, too, if you were very lucky. Then there was split-band tube gear, covering low band (with or without FM) and high band.

The first transistorized gear was low band only, although mercifully it was not single channel except in some laboratory proto-types. This was quickly followed (quickly being a year or two) by "all band" transistorized equipment, covering not only low band and high band, but the so-called mid-band(s) between low band (54-108 MHz with FM) and high band (174-216 MHz). Then, finally, there was "all band" meaning 50/54 MHz through and including 300 MHz.

Inter-mixed through much of this were "single ended" and then "double ended" amplifier designs. Single meant the output stage had a single active unit or transistor; double connoted a pair of push-pull stages, operating in such a design mode that second order harmonics were controlled if not eliminated. But we are getting ahead of ourselves.

And into each of these equipment-design philosophies there were from one to a dozen or more companies, each offering its own particular amplifier design or designs. Each made claims that his was the most modern, the most efficient, the latest and the best performer. Obviously a few were not all that hot.

But still, each was bought by at least a few systems then building or re-building, and each today delivers (still) some type of pictures to some quantity of cable system subscribers.

Through time systems change hands and systems change technical people. What was one man's ideal amplifier is another man's albatross. During the latter half of the 60's and even into the 70's when a system changed hands or people, changing amplifiers became the "in" thing to do.

"Now that we've bought the system, what's wrong with the pictures in Left Overshoe" asked management of engineering. "Nothing that those new 'XYZ' bi-directional, push-pull gold plated amplifiers won't cure" was often the answer.

The fact of the matter is, and always has been, that design engineering people invariably have utilized the best component parts (meaning transistors in our case) they could lay their hands on, **at the time of** the amplifier's design. The history of CATV plant amplifier design has largely been a history parallel to the Detroit answer to new car innovations; **change the model completely,** and announce that 'this year's version is much better than last year's version'. Only a handful of plant amplifier designers have followed the VW approach; keep the model the same, but update the 'guts' internally whenever technology warrants an updating. And each new generation of component parts (i.e. transistors) from the solid-state people has signaled a new round of new models; typically touted as better than their forebearers.

Simply put, the old has seldom been re-visited. It was always more "efficient marketing" to dis-card the old and come out with a whole new model. The results have been, in some cases, predictable. Just about the time the 'feed-

back-loop' from designer to production line to field user was completed (i.e. there were field reports coming back into the designer after sufficient units had been produced to provide meaningful data), **the model got changed.** The designer invariably incorporated the latest technology into the latest unit, but just as often neglected to spend very much (if any) time on updating those units already in place.

At some point in time the cost-effectiveness of throwing out the old every three or five or even seven years becomes questionable. Certainly technology does change, and certainly in five or seven years in CATV history there have always been major improvements in transistor performance. But the basic amplifier design changes not that substantially, as a rule.

At some point in time, a man faced with replacing say an early Jerrold (or Vikoa, or Ameco) solid state plant would find himself facing a **major** capital **re**-investment. To serve customers already served, and to largely reduce maintenance problems and increase customer service quality. Seemingly this man would carefully consider **all** of the alternatives to wholesale amplifier replacement from trunk to extender. He might even consider **leaving** the amplifiers in place, and updating them to the latest technology.

How Much Improvement?

Virtually every line amplifier piece ever produced has its own selection of non-pluses. Some have a susceptibility to second order beats; others have noise (figure) problems. Still others lack the ability to handle 12 (or more) channels at reasonable output levels without creating objectionable cross-modulation. The operating parameters (second order, noise, etc.) of the particular unit or design is and was originally a function of the design parameters of the particular transistors chosen for the amplifier by the design engineer, and, the way the design engineer chose to run or operate the device. Just the right amount of applied operating voltages, the right amount of current allowed to be drawn by the device are but two of the parameters which inter-act with the final performance characteristics of the amplifier.

There have been dramatic improvements in (1) transistors, and, (2) knowledge of proper transistor operating parameters during the 70's. There may be a plateau or leveling off of the improvement in transistor technology upon us at the present time however; it appears that **most** of the dramatic improvements in **existing families** of transistors are now in place and that additional improvements will come in whole new families (as opposed to generations) of active devices. It follows then that if you knew what you were about, understood transistor operational characteristics versus performance criteria, that you could sit down with an older solid state CATV amplifier and **re**-select a **better** transistor family tree for an **existing** amplifier design. It also follows that if you did this work very carefully, that you would gain improvements in at least four critical-to-CATV-system-performance areas, they being:

(1) **Cross modulation** (Xmod),
(2) **Triple beats,**
(3) **Second order,**
(4) **Noise figure.**

Notice that none of these four areas has to affect amplifier spacing or location; each simply deals with the **quality** of the picture or signal passed through the amplifier **at its present location.** This is a potentially critical or key consideration, since most rebuilding approaches taken result in modest to substantial re-location of amplifier units to accomodate the differences between "yesterday's gain/equalization parameters" and today's newer generation equipment.

All four areas affect not only signal performance along the existing plant, but they **also** play a big part in just how **far** a plant can be "extended" to provide signal-service to as yet unserved regions. The ability to constantly extend **the length** of a plant, in one or more directions, is another reason a system operator gives serious consideration to a major plant re-build. If a system is into the Xmod or noise problems at the **end** of **present** lines, and the community continues to grow beyond the boundaries artificially established by the operating characteristics of the plant itself, at some point the pressure for extension of service becomes a key ingredient in management's decision **to rebuild** the existing plant.

At this point it would be well to identify at least one of the major technology houses which has pioneered the world of "rebuild your amplifiers/not your plants" in CATV. That would be **Broadband Engineering, Inc.** (535 East Indiantown Road, Jupiter, Florida 33458). Broadband began as a parts supply house for CATV, under the tutorage of one Bob Savard. Savard came to his present occupation through the ranks of a major semiconductor supplier. His background in solid state devices has served him well, because going into his "parts supply" avocation Savard understood well just what made a good or bad part vis-a-vis CATV performance.

The Broadband story is one of quiet application of good common sense and plenty of sound engineering. Savard is a "nut" for measurements. He lives and breathes in symbols; like Vce, Vre, Re, Ic, Pt, Vbe and he is most at home seated before a fancy test fixture running knobs and switches and tracking meters and chart recordings. Watching Savard at work tells you instantly that if there is a great home in the sky where CATV type people go,

Savard's position there will have to be that of being the supreme "component analyst" for the industry.

Savard dis-likes component suppliers who cut corners and fail to maintain product integrity. Without naming names, he can rattle off dozens of examples of transistor this or stud that which has a 20 or 30 or even 70 percent "failure rate" when it is checked on his precision analysis equipment. **"We are at the mercy, as an industry, of the people who make the descretes. One shipment from a supplier will be just fine, perhaps 10 percent of the devices will fail in some important parameter. But the next shipment will be so bad that we will be lucky to get a 20% yield".**

Savard's Broadband got into the component checking business because of his own personal experience in representing component manufacturers. **"You get to know which is a good, consistent, part and what is an unreliable part when you are selling or delivering them yourself"** he notes. So when Savard's Broadband Engineering came into being just a few short years back, as a supply house for replacement parts for CATV amplifiers, one of the first big investments he made was in a component checking facility. It has paid off. Broadband's reputation for supplying "good parts" has made the small Florida company the leader in the field as far as most people are concerned.

BOB SAVARD has made his mark on the CATV world by becoming the industry's component-part-specialist.

The next problem Savard tackled was parts availability. **"Nobody has proper manuals. I've never seen an industry that had so few manuals for so much equipment. And even when you have the manuals, if you have not been very careful as an operator to check your manuals against the equipment you actually received, you have a manual with a schematic that represents a unit that was manufactured months or years before yours was. In short, your manual and schematic often does not check with the unit you actually have in your line."** So getting a "handle" on what parts were required for which piece of equipment was an early, time-consuming, and often frustrating chore at Broadband. It took several years to develop a cross referenced system, but Savard now believes his company has one of the best (if not the best) parts cross referencing systems in the CATV world today. **"People call here asking for** 'that little capacitor that sits down behind the stud in the XYZ amplifier, next to the RF choke' **and we can usually find the right part, select it from the test stock and get it off to them that same day"** notes Savard with satisfaction.

Through the years several CATV plant electronics supply companies have appeared on the scene, and left. That has left the industry with hundreds or thousands or tens of thousands of "orphaned amplifiers" in place, humming along (pardon the pun) with some very nervous system owners and managers. **"We decided early that if we were going to be of real service, the first thing we had to do was to**

make certain the parts we kept on hand were not simply for the Jerrold amplifiers. The world may be largely amplified by Jerrold line amplifiers, but to the guy who has an SKL plant or a Coral/Vikoa plant the ready availability of Jerrold parts does him no good. There may be a few really small run CATV items, such as a 16 year old modulator, that we can't cross reference here, but it is the exception not the rule" notes Savard.

One of the fall-outs from the testing procedure for all parts is a rather interesting 'warranty' which Broadband offers. **"100 percent guarantee on all parts. Period. No quibbles. If a part is bad, a guy gets a replacement, promptly."**

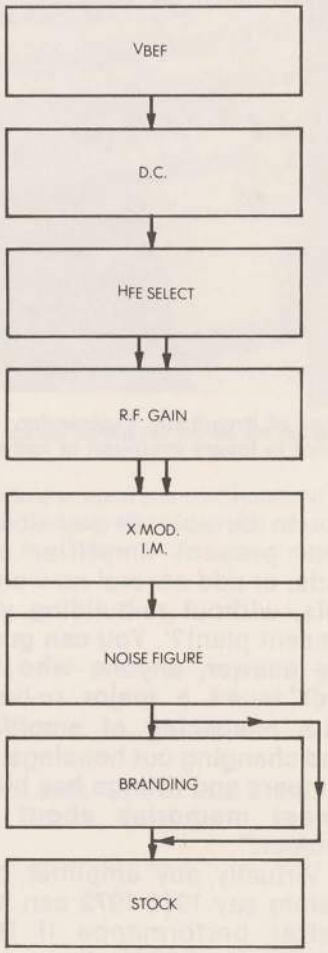
From little acorns larger trees do grow. Once Broadband had a decent handle on the replacement parts business Savard's innate curiousity got him to thinking about amplifiers as whole units, not as descrete parts. **"We had acquired the necessary test equipment to evaluate parts early on. If we knew that the parts were good, and if we had a system worked out to rate parts above the simple 'good'** (go) **and 'bad'** (no-go) **it followed that we also had the ability to hand select certain parts that were especially good. So I began to wonder one day what would happen if we took a line of older equipment, such as the early Jerrold "T" line gear and set out to design state-of-the-art replacement modules for the guts of such units."**

Into this scenario came a Florida based cable engineer with plenty of smarts and the one key ingredient Savard felt he needed most; practical cable operating experience. The fellow's name was Chuck Wise, and with Chuck on board Broadband broadened its operating base to include what was subsequently dubbed "MOD-KITS".

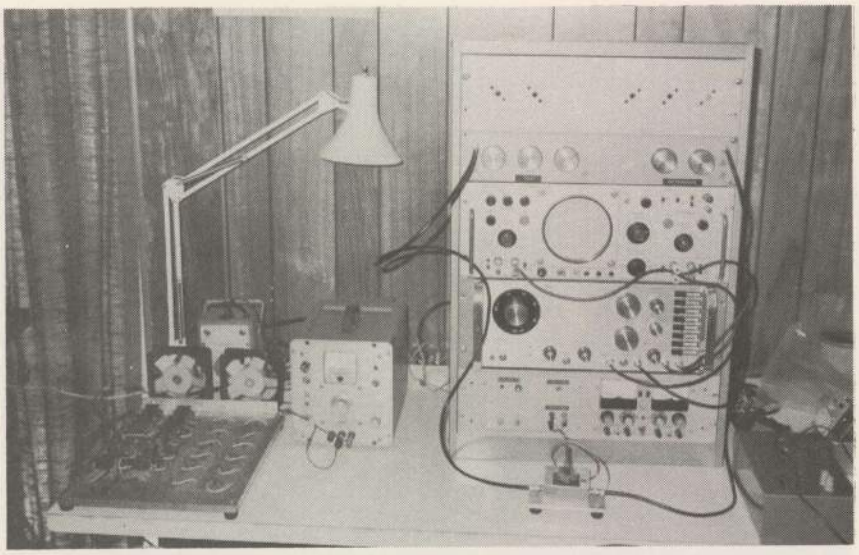
"Our concept was really quite simple. We knew that if we took a hard look at what the limitations were in existing,

PARTS CHECKING is performed on all incoming components before they are placed in the stock room. Units that do not meet Broadband standards are returned to the supplier.

R.F. SEMICONDUCTORS FLOW CHART



EQUIPMENT	TEST
TEKTRONIX 575	EMITTER BOND RELIABILITY TEST VBEF: 1.4v AT 0.5 AMP
TERADYNE T-217	D.C. SPECIFICATIONS
TEKTRONIX 575	SELECT HIGH/LOW BETA FOR MATCHED PAIRS
TEXSCAN VS50 TEKTRONIX 503 B.T. 4102	GAIN AT 270MHZ (OTHER FREQUENCIES ON REQUEST) SELECT PAIRS ±o.25dB
H.P. 8558 DIX HILLS SX16 DIX HILLS R-12 BOOTON 92A	12 CH. x MOD 2 TONE I.M. 3 TONE T.B.
H.P. 34ob H.P. 343B AIL 13630 TRYGON DL40 H.P. 608E	210MHz & 270MHz NOISE FIGURE
MARKEM	



PORTION OF CHIP burn in and performance testing area shows units ungoing time-test (left) and operating characteristics tests (center).

PARTS FROM STOCK is one of the innovations of Broadband Engineering; air, UPS blue label and other techniques are utilized to insure overnight or two day delivery to most of the country.

well used CATV amplifiers we could find several areas in each amplifier where if we changed out parts and made subtle modifications in the associated design we could improve the operating parameters of the amplifier." The timing seemed right. Some of the early solid state plants were pushing the 7-10 year age range, and Savard knew that as the industry and communities had grown in that period of time the demands upon the cable plant had increased. **"I talked with dozens of system managers and system owners; I asked them** 'How would you like to be able to say double your present amplifier cascade, or add several new channels, without re-building your present plant?'. **You can guess the answer, anyone who has ever faced a major re-build, with re-spacing of amplifiers and changing out housings and jumpers and fittings has bittersweet memories about the project."**

Virtually any amplifier built before say 1970-1972 can have better performance if it is 'modernized' with the **proper** parts. If the system in question can **re-build the amplifiers and not the plant,** it is not only money ahead, it is time ahead. **"Plus, if the system operator has any technical people at all, he can take our MOD-KITS and on a one-amplifier-at-a-time basis pull out an amplifier board from his operating plant, make the modification in his own shop, and then put the amplifier board back into place."** Which simply means the system operator controls his amplifier re-build by setting his own pace, whether the pace is established by his own internal cash flow or by his time-available criteria for his technical personnel.

Some of the improved performance characteristics Broadband attributes routinely to MOD-KITS is a little difficult to grasp. Even when you see it in black and white. A table here lists some of the improvements Broadband measures with suitably modified amplifiers.

When it became apparent that (1) there were worthwhile improvements which could be made with the MOD-KIT approach, and (2) there were systems interested in this approach to updating system capabilities, Savard made another major investment decision; one not to be sneezed at when you are young and struggling. **"We went to Dix Hills and acquired an automatic distortion plotter package; augmenting it with the other equipment necessary to produce hard-copy plots of the various parameters we wanted to check".** There are not very many 'Dix-Hills' packages around; but if you are going to do accurate analysis of second order, triple beats and things like that, there is virtually no substitute for the package. It turned out to be a wise decision for Broadband because it established their credibility for their MOD-KITS.

"People simply find it hard to believe that you can effectuate 15 dB improvements in Xmod or triple beats and second order simply by changing out some parts" notes Savard. **"The industry -57 dBmV conscious for crud**

like this, but the general method of 'measuring' has been to keep on cascading until you start to see the crud in the pictures. That's like having a speedometer in your car that only tells you when you are exceeding the speed limit; you have no way to know how much faster you can go without exceeding the limit!"

The 12 channel limitations of single ended equipment have been well know for quite some time. A technical paper presented at the 1971 NCTA Convention by Daniel Lieberman (GTE Sylvania) puts it all into proper perspective (see capsule report here). The bottom line is that it may well be possible, without a phaselocked headend and without double ended (push-pull) amplifiers in the plant to operate with a 13th channel on the system if your plant amplifiers have been suitably updated to modern state of the art operating parameters. That will

CASCADING AND IM DISTORTION

At the 1971 NCTA Convention, Daniel Lieberman of GTE Sylvania, Inc. presented an excellent treatment of amplifier design versus second and third order product generation.

Lieberman found that the magnitude of the cascade effect depends upon the low frequency phase intercept of the phase shift versus the frequency curve of the amplifier. It was further found that the phase intercept point, if carefully controlled, could be handled in such a way that very long cascades of amplifiers could be handled without the traditional IM products building.

Lieberman made the point in 1971 that 'Repeater amplifiers for state-of-the-art cable TV systems generally exhibit specifications for noise figure of about 9-10 dB and for cross modulation of about -93 dB at operating levels. This is sufficient for achieveing cascade operation to system lengths of 1,000 dB at operating levels of 30-35 dBmV'. Lieberman also noted '. . .improved performance in these areas could be achieved by the use of more expensive transitor devices. . .'.

Lieberman noted that second order distortion products do not directly add from amplifier to amplifier unless the extrapolated low frequency phase shift is equal to 0 degrees of phase. In fact, if the low frequency phase shift is purposefully set at 180 degrees, a direct cancellation of second order distortion in every-other amplifier can (and will) occur in the system. Holding that type of precise phase control is at best difficult, and probably impossible in the field. But it is worth noting that for phase shift values between 0 and 180 degrees (and 180 through 0 degrees) that there is also **some amount** of cancellation of second order products. The worst case, or pure addition of the products, occurs only in the 0 degree region.

Lieberman further noted that the third order distortions will cascade on a voltage addition basis, or as 20 log n, where n is the total number of amplifiers in cascade.

Thus, as Lieberman pointed out, if a repeater amplifier and its cable combination could be so designed that the zero frequency intercept is close to 180 degrees, then the absolute magnitude of the growth of the second order distortion would not be much greater than from any one amplifier.

Controlling the IM in a single amplifier is a matter of proper (transistor) device selection (both for the family of the transistor and the actual device chosen after adequate and suitable testing), circuit biasing, feedback techniques and the proper selection of the zero-frequency phase intercept.

Lieberman comes to his bottom line in this way. IF the designer of the amplifier has paid careful attention to his design parameters for an amplifier, the second order problem should largely take care of itself. This results in substantial freeing up of the taboos of midband channel carriage for single ended systems, with the primary limiting factor becoming not second order distortions but the third order products.

As Broadband's Savard points out, the third order products are similarly affected, in single ended systems, by the careful choice of descrete transistor devices, plus the way the device is operated. In the end, the practical limits for single ended systems, in terms of channels carried and in terms of cascade length may not be nearly as limited as 1960 and early 1970 data sheets may prescribe.

MOD-KIT PERFORMANCE IMPROVEMENTS

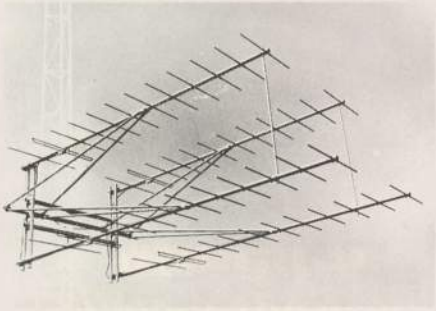
While Broadband MOD-KIT units are available for far more units than those listed here, these typify the type of performance improvement which can be expected with carefully engineered updating of equipment already operating in your system.

Amplifier Type	Improvements with MOD-KIT			
	Xmod	Triple Beats	Second Order	Noise Figure
Ameco PII (trunk)	**+15 dB**	+10 dB	+ 2 dB	+2.5 dB
Ameco PII (bridger)	**+18 dB**	+15 dB	+ 3 dB	—
Cascade TLC	+ 3 dB	+ 7 dB	**+15 dB**	+3.0 dB
Cascade T.M.T.A.	+ 8 dB	+ 8.5 dB	**+15 dB**	+2.5 dB
C-COR T-350	+18 dB	**+19.5 dB**	+10 dB	+2.0 dB
CORAL 225	+ 6 dB	**+10 dB**	**+10 dB**	+2.2 dB
CORAL 429-M	**+19 dB**	+15 dB	+ 4 dB	+3.2 dB
Jerrold SMM/SAM	**+10 dB**	+ 9 dB	+ 4 dB	+2.0 dB
Jerrold SLE-2P	**+ 8 dB**	+ 6 dB	**+ 8 dB**	+2.0 dB
Jerrold SAM-PT	**+18 dB**	+14 dB	+11 dB	+2.0 dB
Kaiser KCBO-2/4	**+14 dB**	+12.5 dB	+ 8 dB	—
Kaiser KCAG/MG	**+12 dB**	+10.5 dB	+ 3 dB	+3.0 dB

GAIN AND FLATNESS check on modified popular-brand amplifier under the careful direction of Chuck Wise.

OPERATING PARAMETER PLOTTING with the HP "X"/"Y" plotter develops individual operating curves for single amplifier amplification devices, similar to those shown here for PT 4145 unit (versus B-022 device).

Sitco just perfected a quad and pre-amp combo you won't believe until you mail the coupon.



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Part and Parcel

Some modifications can be made with changeouts of a few descrete parts. Others (such as the TML) require major changes. Some amplifiers were originally designed around PNP germanium transitors, and their negative supply voltages were accomodative to the peculiarity of the transistors. Obviously you cannot update an amplifier with **newer** PNP germaniums if the state of the art has passed them by, **and there are no such later versions available.** So in cases like this, Broadband pulls out the guts of the amplifier and starts over with a new mount-in board.

When you do this, with say the Jerrold TML (Savard estimates there are at least 5,000 of the early Jerrold solid state units still in service) you can buy another 5 to 10 years of useful, low investment-cost service from the original amplifiers. And you can have much improved electrical performance and reliability in the process. **Without major plant re-construction.** The approach, in this case, is to provide the system with a modification "kit" that includes a pre-wired circuit board, with an IC chip (TRW unit in use in later version gear) and a fully regulated power supply. Broadband has designed the TML modification and the TBA-2 modification so that the system operator can continue to operate the TBA-1 bridger un-modified **if** he so chooses. Additionally, modern-approaches to transient and lighting protection are also included, with lightning arrestor units at the input and outputs and a TransZorb device on the IC chip. The operating performance is the bottom line: The TML-1 exhibits, after modification, at + 32 dBmV output (1) cross mod of better than -90 dB, (2) triple beats of better than -100 dB and second order beats of better than -85 dB. The noise figure comes in at 10 dB.

It is important to keep in mind, when you are comparing

the **original** specs on **any** equipment to the modified specifications after the equipment has been MOD-KITTED, that an amplifier "doubles" its output capability when Xmod and triple beats are "improved" by 6 dB, or, when noise figure or second order is improved by 3 dB.

If you take just one part in the process, shown here in plotter-graph form from the Broadband plotting system, such as the PT 4145 (Coral/-Vikoa part) you have a dramatic indication of what part selection and/or updating can amount to. Comparing the original PT 4145 against a Broadband B-022 part there is a 15 dB improvement in the triple beat spec. The Ft (or measurement of highest useful frequency of the device) is 1200 MHz for the Vikoa/Coral part and 3000 MHz for the Broadband part.

Now when you take the parts and plug them into an amplifier the results are even more interesting. Using a model 429 M / Coral amplifier (serial number 14542) the performance specifications of the unit are plotted here before and after the Broadband model BMK 404 MOD KIT was installed. The significant points to note are as follows:

(1) **The current drawn** by the four stages is almost identical (247 mA prior to modification and 243 mA after modification);

(2) **The noise figure** was improved by 3.25 dB;

(3) **At +32 dBmV output** cross mod for 12 channels was improved by 18.5 dB, at +42 dBmV output cross mod was improved by 18 dB;

(4) **At +32 dBmV output** triple beat was improved by 13.5 dB, at +42 dBmV output triple beat was improved by 13 dB;

(5) **At +32 dBmV output** second order beats were improved by 4 dB, at +42 dBmV output second order was improved by 4 dB.

Serial # 14542 BEFORE

AMPLIFIER TYPE 429 M / CORAL DATE 1-28-77

	Vce	Vre	Re	Ic	Pt	Vbe	P/N
Q1	12.2v	17.5v	430 ohm	41ma	.5w		80099
Q2	25v	5v	68ohm	74ma	1.84w		PT 3540
Q3	12.2v	17.3v	300ohm	58ma	.7w		80099
Q4	25v	4.97v	68ohm	73ma	1.83w		PT (3540)
Q5							
Q6							
Q7							
Q8							
Q9							
Q10							

B+ 15v B- 15v I Total

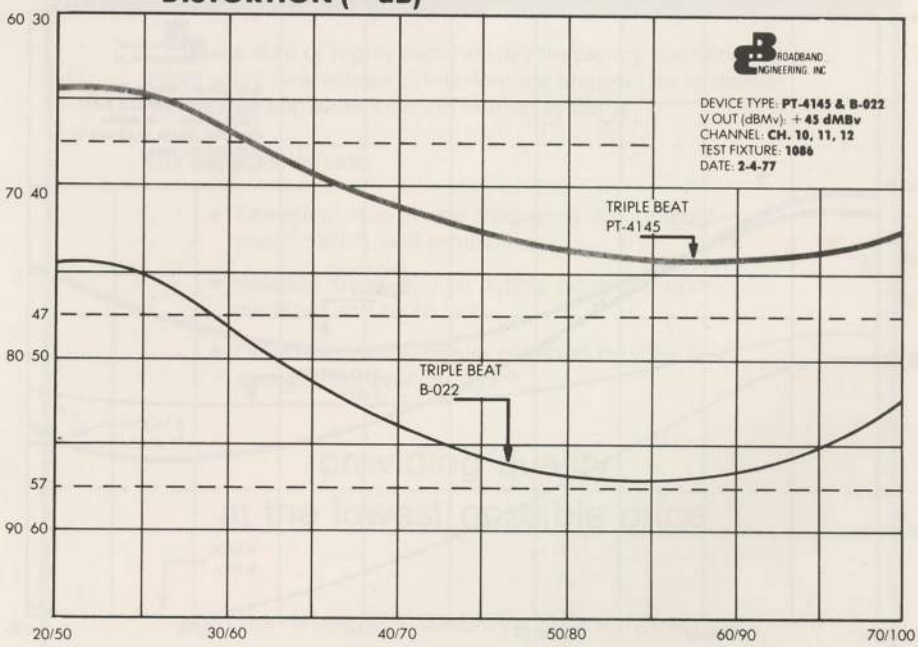
X Mod:
1 # Ch 12 on Ch # 13 V out: +32 -80½ dB
2 # Ch 12 on Ch # 2 V out: +27 -79 dB
3 # Ch 12 on Ch # 13 V out: +42 -60½ dB
4 # Ch 12 on Ch # 2 V out: +37 -58½ dB

T.B.
1 # Ch 10,11,12 on Ch # 11 V out: +32 =93 dB
2 # Ch 10,11,12 on Ch # 11 V out: +42 -73 dB

S.O
1 # Ch 4+144 on Ch # 13 V out: +32 -71 dB
2 # Ch 4 144 on Ch # 13 V out: +42 -61 dB

N.F. F Ch-13 MHz 9½ dB (Operational)

DISTORTION (−dB)



Serial # 14542

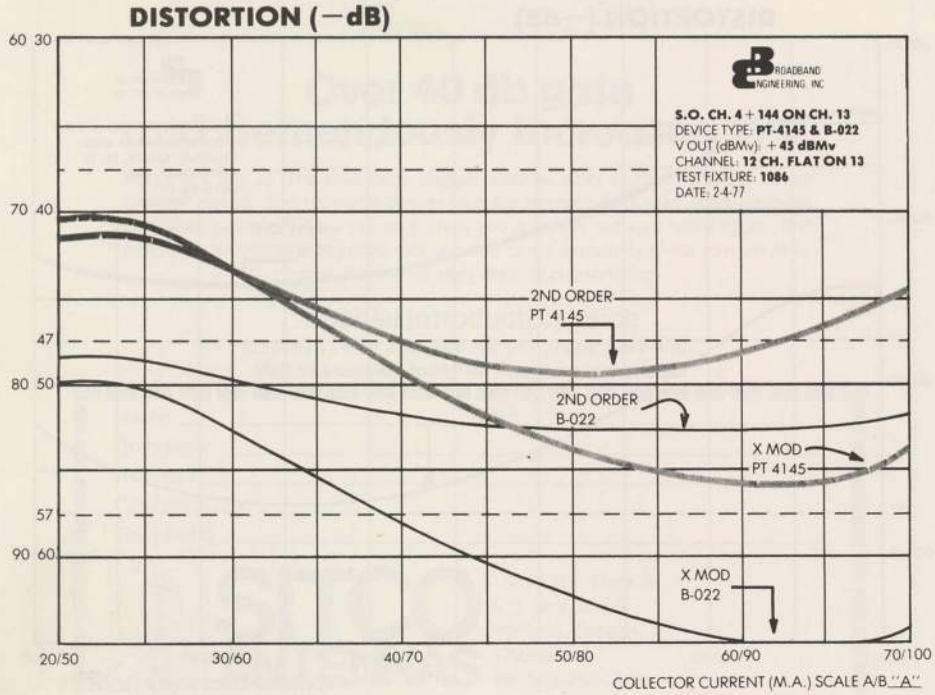
AMPLIFIER TYPE 429 M / BMK 404 CORAL DATE 1-28-77 After

	Vce	Vre	Re	Ic	Pt	Vbe	P/N
							(White)
Q1	16.9v	13.1v	430ohm	30ma	.51w		B-020
Q2	17.6v	4.77v	68ohm	70ma	1.2w		B-016
Q3	11.9v	17.5v	300 ohm	58ma	.69w		B-020
							(Red)
Q4	16.4v	4.78v	56ohm	85ma	1.4w		B-016
Q5							
Q6							
Q7							
Q8							
Q9							
Q10							

B+ 15v B- 15v I Total

X Mod:	1 # Ch 12	on Ch # 13	V out: +32	-99 dB	
	2 # Ch 12	on Ch # 2	V out: +27	-79 dB	
	3 # Ch 12	on Ch # 13	V out: +42	-79½ dB	
	4 # Ch 12	on Ch # 2	V out: +37	-76½ dB	
T.B.	1 # Ch 10,11,12	on Ch # 11	V out: +32	-106½ dB	
	2 # Ch 10,11,12	on Ch # 11	V out: +42	-86 dB	
S.O	1 # Ch 4+144	on Ch # 13	V out: +32	-75 dB	
	2 # Ch 4+144	on Ch # 13	V out: +42	-65 dB	

N.F. F CH13 MHz 6 dB (operational Gain)



The limiting factor in the modification of **this particular brand and model** of amplifier would then be the noise figure improvement (3.25 dB) and the second order improvement (4 dB). In both cases, the amplifier (and the system if all similarily affected) just obtained "double" cascading ability with the modification in place.

The actual degree of improvement, whether or not you could add say a mid-band channel to the system after the modification, or a single (or multiple) lower-super band channel to the system (for semi-secure pay cable) will of course depend upon the exact channel makeup in your system, and the type of equipment (make AND model) which you have throughout your plant.

As Savard points out **"There are hundreds of descretely different amplifier makes and models out there, and while we are constantly increasing the list of units which we have developed and tested modification kits for, it is only natural that going into this project we have chosen to develop modification kits for the older, more common units first."**

Not every amplifier will eventually have a modification kit available. **"Some are so bad generically that the proper modification would involve chucking every part inside and starting all over".** Then there are some with mechanical problems, and a few with "unusual" design approaches. The Ameco ATM-60, for example, has such problems. For one thing, the ATM-60 has its AGC coming out of the circuit in a position which makes modification difficult. For another thing, there are around 90 "rivets" in the ATM-60 that would have to be punched out with a drill press (the TML has 10) just to get the existing board clear of the housing.

Unusual Field "Tricks"

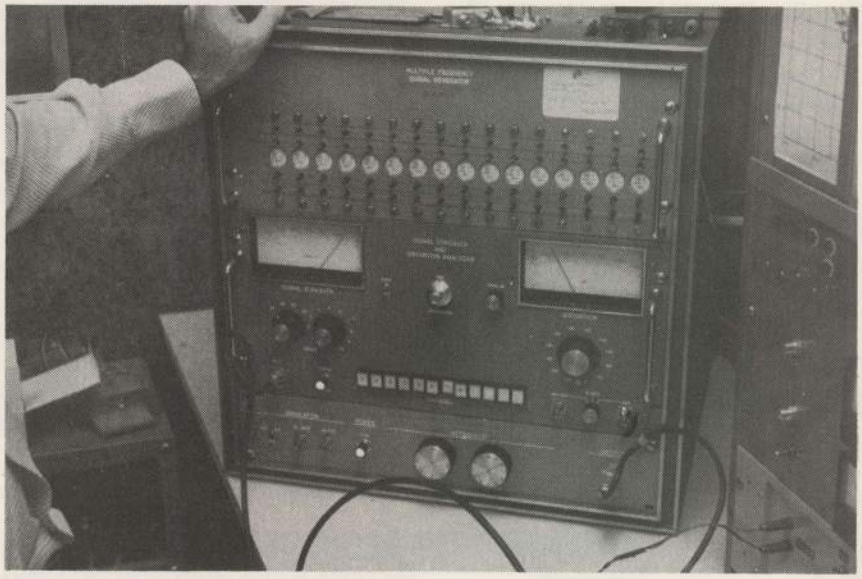
In the process of analyzing what makes a particular amplifier fly right, there are any number of interesting dis-

coveries. Some are well known by the users but little appreciated by non-users; others are tricks that may have escaped the average user up to the point where he seriously considers updating the individual amplifiers; not the whole plant with new gear.

Take the Starline 20 amplifier for example; a push-pull unit. Savard has noticed that after a descrete part replacement (i.e. transistor) in such a unit, the balance pot in the amplifier (that tweeks the balance **between** the **two** output stages) is more often than not in the **same** yellow-paint-sealed position that it left the factory with. **"When you change out one or both output transistors—and you almost have to change them both if one goes—that balance pot needs to be re-tweeked to achieve the lowest second order rejection. But most people don't have the capability to measure second order, so they leave the pot in the original position. That means that for that particular amplifier, with a part replaced in the field, the full cancellation benefits of a push-pull stage are probably no longer being recognized. The two halves of the output stage are not balanced."**

In Bradenton, Florida, where Broadband MOD-KITS were installed in a 27 amplifier cascade of SKL brand amplifiers, the system measured 35 dB signal to noise ratio before the modification. It **expected** to have a 3 dB improvement, or 38 dB signal to noise **after** the modification. Wonder of wonders, it measured 44 dB signal to noise after the modification. Incredible?

"We don't think so—and we take very little credit for the improvement above the 38 dB point" notes Savard. **"What happens is that when a system goes in and makes a modification on the amplifiers, the wise system operator will at the same time direct his people to clean up and re-seal all splices, fittings, connector cables and so on. It is the cumulative benefits of a fraction of a dB here and a fraction there, plus the first real balancing the system has had in a long time that brings the extra improvement above the theoretical improvement".**



HEART OF AMPLIFIER diagnostic system is Dix Hills package. Broadband documents "before" and "after" parameters on all units with MOD-KITs available.

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A Starline-I plant had a peculiar type of cross-mod on television channel 5. In diagnosing the problem, it was determined that the pilot carrier (between 72 and 76 Mhz, or just below channel 5) was the apparent culprit. **"People just keep adding carriers to their system without ever considering what these additional carriers may do to cross-mod products. There is the mistaken belief that if a carrier added is not modulated with a 15.75 kHz sync signal, that it can't bother you very much. In this situation, we found 18 carriers on the system with a spectrum analyzer, all sufficiently potent to be considered in the real world of cross-mod computation. We eliminated the channel 5 cross mod with a special mod-kit that modified the pilot carrier sensing circuit in the amplifier to make it work off of television channel 5, rather than the special carrier. By eliminating the extra carrier, we eliminated the channel 5 Xmod and the cost was $7.50."**

A good part of the world runs on Starline-I equipment. Savard notes **"California operators are particularily ingenious about pushing Starline-I gear to its very outer limits. We have provided Starline-I modifications to people who are operating with 21 channels through Starline-I gear".**

Not Everyone's Cup. . .

Seemingly, if such wonderful things can be done with smart engineering, carefully selected parts, and plenty of technical backup such as Broadband provides, the world of massive plant re-builds might screech to a big halt in a hurry. Why re-build the entire plant, one might ask, if one can re-build descrete amplifier units?

Not everyone would or does agree. **"Most of the bigger MSO's just naturally think in terms of new gear and new everything else. A few have made some test re-builds using the amplifier approach, and we have monitored the results closely enough to know that they work very well. Maybe its an 'appearance' thing; the systems seem happier spending lots of money and making a big deal of changing out the whole plant. But if I was a system operator interested primarily in my bottom line, I think I'd spend alot of careful time studying how I could accomplish the same end result** (i.e. better pictures, over more cable) **for less bucks."**

Savard makes the point that in the past systems have had excess bucks generated which in the 50's and 60's at least usually got earmarked for a "total rebuild" every five to say seven years. **"They were using tax dollars in those days, and the equipment suppliers knew when a guy had run out of depreciation and he therefore would be receptive to a strong pitch for a rebuild with the latest super-everything-amplifier line."** But in Savard's mind, those days may be gone; at least for awhile. **"There are new ways to spend 'tax dollars' now. There are $35,000 earth terminals, and the newly emerging low cost microwave packages. Perhaps the day of the periodic re-build is a thing of the past; at least for many operators".**

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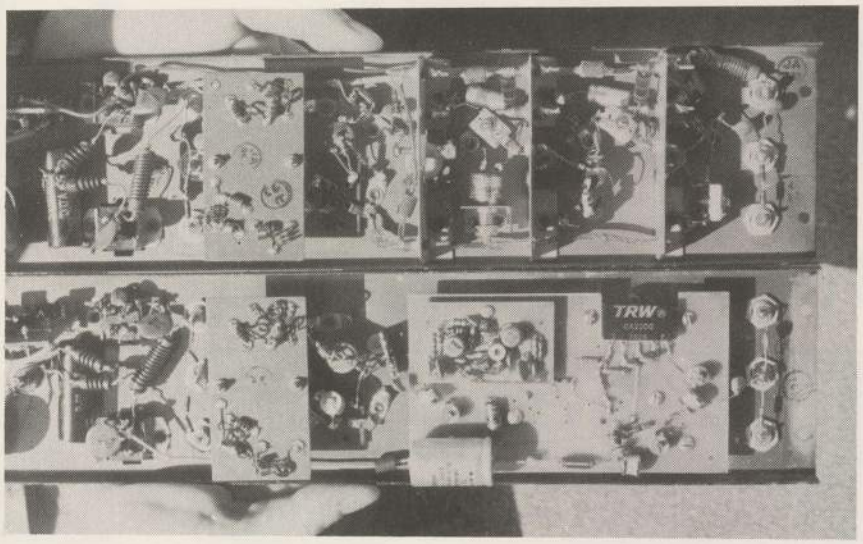

BEFORE (top) and AFTER (below); two versions of the same amplifier, showing the MOD-KIT in place (bottom unit). TRW chip replaces former descrete-stages of amplification, with improved performance.

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Leading manufacturer in land mobile communications field has an opportunity for an experienced RF Design Engineer. You will be involved in new product development, not unlike those products used in CATV installations; filters, cavities, duplexers, ferrites, and antennas and associated RF devices from 30 to 1,000 MHz. This is an excellent growth position for the right professional. Interested and qualified applicants should send a resume with salary history and requirements in complete confidence, to COMMUNICATIONS INDUSTRIES, INC., P.O. Box 45006, Dallas, TX 75245.

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Bob Savard, Chuck Wise and the group at Broadband Engineering are a part of a new generation of CATV technology. Only unlike the people who are making CATV microwave more affordable by pushing the limits of low cost new space age technology, Savard and his crew are back working the other side of the street. **"I keep returning to the VW"** notes Savard. **"It has an engine, four tires, and a steering wheel. It will get you there. Older style amplifiers have plugged along for many years getting TV signals to the customers. Replacing all of the amplifiers and getting involved in a major re-build program is an expensive proposition just to go on serving essentially the same customers you already have. If you have limited yourself to driving your VW around town, you don't suddenly go out and buy a new one simply because you decide to start driving out of town into the suburbs. At most, you might have the vehicle tuned up and put in top running condition. That's our same philosophy with the MOD-KITS."**

TECHNICAL TOPICS

New Texscan Seminars

The world famous five day ($125 fee) Raleigh B. Stelle III "all you ever wanted to know about proof of performance testing" seminars roll on throughout May and June. Scheduled for May are seminar sessions in Atlanta and Lakeland, Florida; scheduled June 27 through July 1 is a session in Indianapolis, Indiana.

If you want to learn what FCC compliance testing is all about, get your hands on some real-world test equipment, and generally come away smiling and feeling better about keeping your system(s) up to snuff, you need to talk with the people at Texscan about these regional gatherings. **For full information**, call Raleigh B. Stelle III at Texscan's Indianapolis toll free number: **1-800-428-9713.**

TVRO Antennas Again

"I read with amusement Mr. Van Hecke's letter which appeared in the April issue of C.A.T.J. I would like to make the following comments:

The 43.7 dBi gain specification was the spec of the Prodelin 4.57 meter antenna at the time of printing. This was accomplished with a prime focus type feed and a nominal 65% efficient antenna. Buzz should know there are many factors that maximize the gain of an antenna; improved accuracy of the main reflector, illumination of the reflector by high efficiency feed design and the dual reflector (cassegrain system).

Prodelin Inc. has elected to use the prime focus type antenna for many reasons; ease of installation and alignment, improved patterns and side lobe structure and lower cost are a few of the reasons.

Your statement concerning a new feed design is correct. This is the feed that we installed at Kalispell, Montana. The combination of this high efficiency feed and the superior surface accuracy of the Prodelin reflector gives us 44.0 dB gain using the prime focus type antenna. This represents approximately 70% efficiency.

It has never been Prodelin's intention to engage in word battles, but rather present the facts to our customers and let them make the decisions in this regard. The gain and patterns of this antenna are on file with the F.C.C. My compliments to your magazine for providing an unbiased forum to the industry. Keep up the good work."

Jerry Pell
Applications Engineer
Prodelin, Inc.
Santa Clara, Ca. 95050

Jerry—

Alright, so now you guys have had your say too. Like we noted in April, the satellite earth terminal antenna biz is bound to have plenty of numbers floating about and everyone connected with the exercise can be expected to look for an 'advantage' over the competition. Both Prodelin and Andrew are well known, respected international companies in the antenna business. You've both had your opportunity to state your case. Now let's get down to the serious business of installing 100 of the small terminals this year!

cata

ASSOCIATE MEMBER ROSTER

NOTE: Associates listed in bold face are Charter Members

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

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Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**) 408—249-0700
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BESTON ELECTRONICS, INC. 903 South Kansas Ave., Olathe, KS. 66061 (**M9**) Character Generators-913-764-1900
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CALIFORNIA MICROWAVE, INC., 455 West Maude Ave., Sunnyvale, CA. 94086 (**M9 Satellite Terminals**) 408—732-4000
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ComSonics, Inc., P.O. Box 1106, Harrisonburg, VA. 22801 (**M8, M9, S8, S9**) 703—434-5965
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JERRY CONN ASSOCIATES, INC., P.O. Box 444, Chambersburg, PA 17201 (**D3, D4, D5, D6, D7, D8**) 717-263-8258
JERROLD Electronics Corp., 200 Witner Road, Horsham, PA. 19044 (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**) 215—674-4800
LARSON ELECTRONICS, 311 S. Locust St., Denton, TX. 76201 (**M9 Standby Power**) 817—387-0002
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Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 (**M1**) 315—682-9105
MICROWAVE ASSOCIATES, INC. 10920 Ambassador Drive-Suite 119 Kansas City, MO. 64153 (**M9**) Microwave Radio Systems-816-891-8895
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 13057 (**M5, bandpass filters**) 315—437-4529
MID STATE Communication, Inc. P.O. Box 203, Beech Grove, IN. 46107 (**M8**) 317-787-9426
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OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL. 60014 (**M1, M9 Converters, S3**) 815—459-5000
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Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, automated ladder equipment**) 712—262-5810
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VITEK ELECTRONICS, INC., 200 Wood Ave., Middlesex, N.J. 201—469-9400
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**) 317—783-3221
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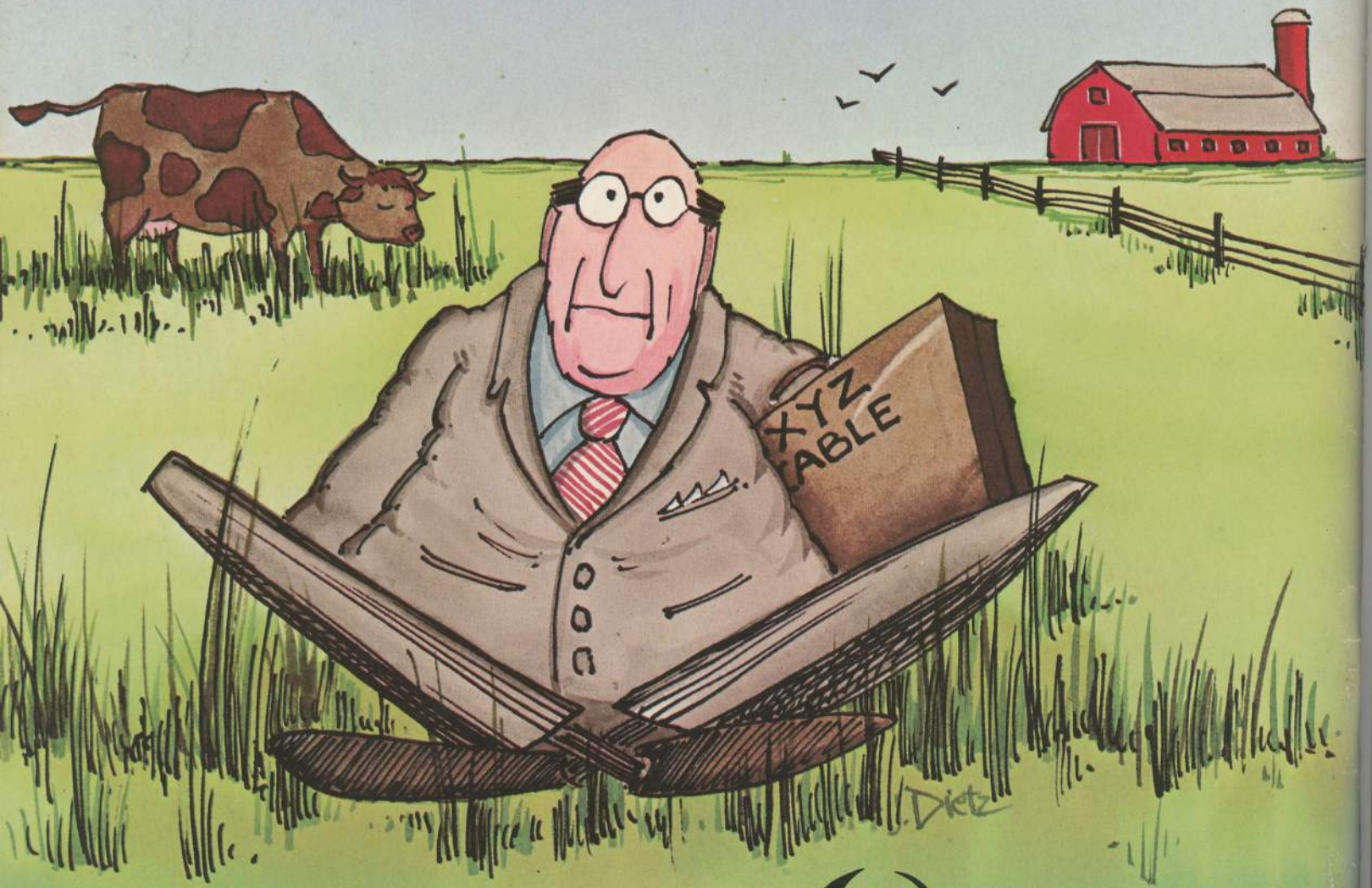

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