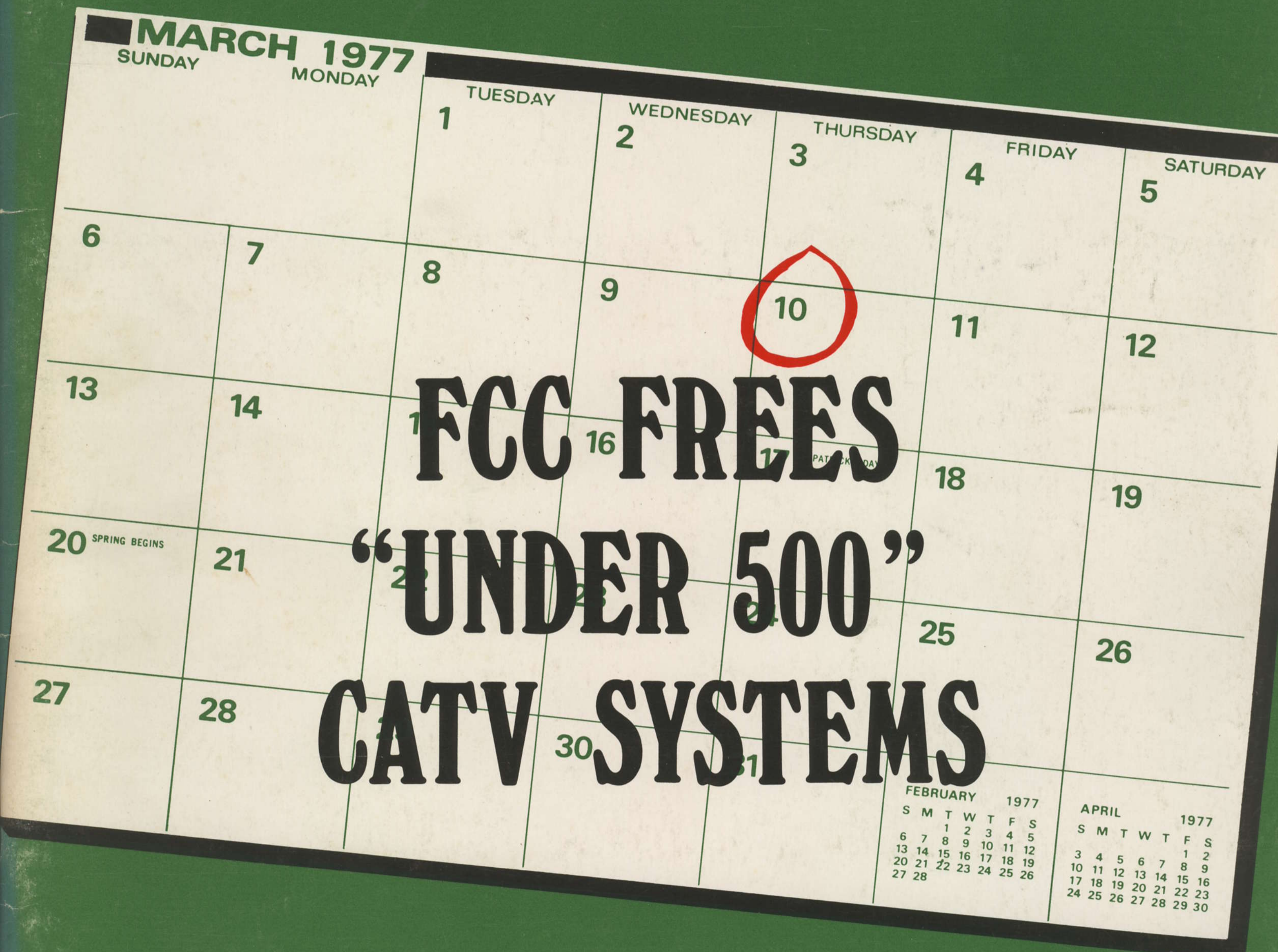
CATJ

MAR 1977



FCC FREES "UNDER 500" CATV SYSTEMS

OFFICIAL JOURNAL/COMMUNITY ANTENNA TELEVISION ASSOCIATION

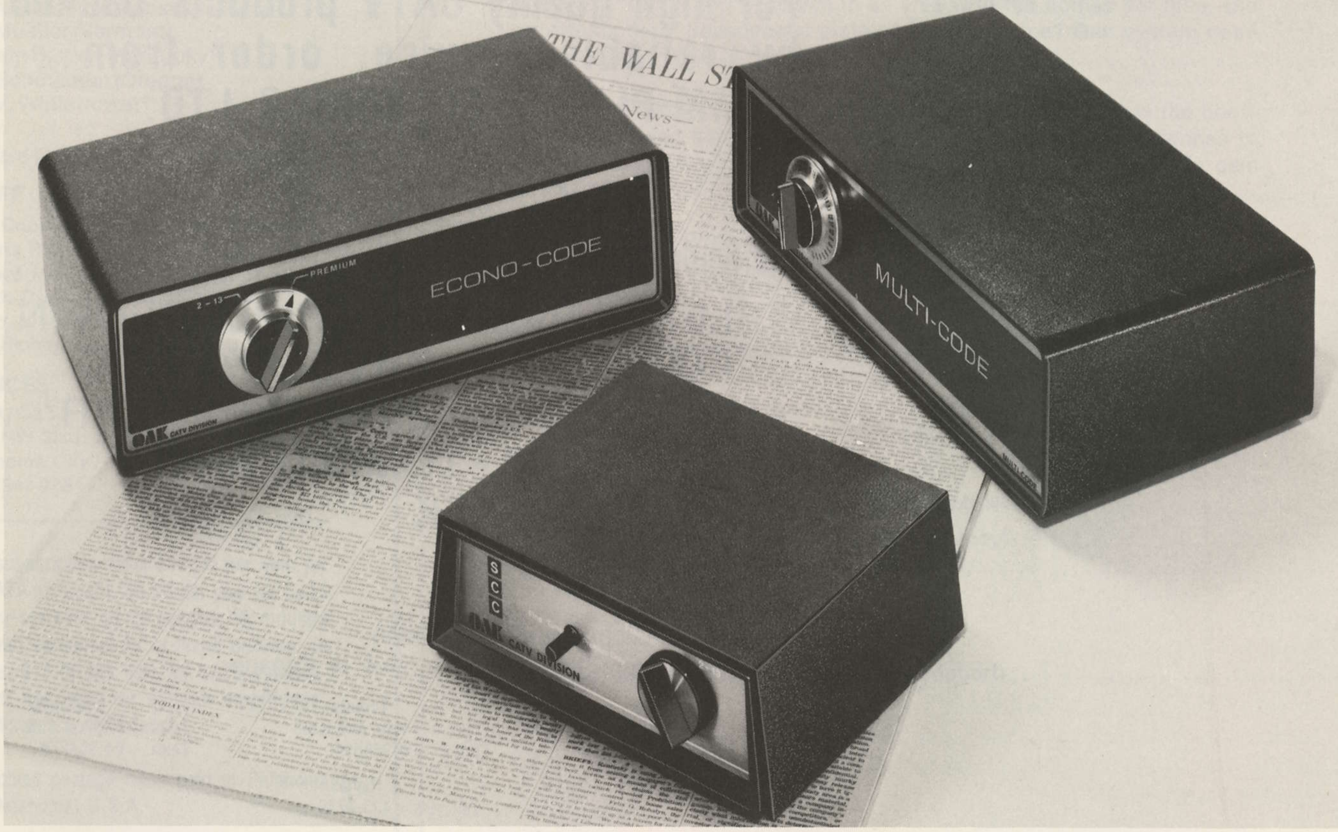
Oak puts profit into Pay TV

Oak designs with your bottom line in mind! These Oak Pay TV products help you increase subscriber revenue, without excessive equipment cost or rebuild, without sacrificing channel capacity or requiring dedicated channels, and with minimum headend equipment investment.

You can choose the Econo-Code single channel converter-decoder, the SCC single channel converter, or the Multi-Code multi-channel converter-decoder. With the Econo-Code or Multi-Code, you're sure of secure scrambling, unscrambling with perfect picture quality, and headend control of the scrambled signal. A single detented rotary selector on each unit controls both standard and premium channel selection, with automatic unscrambling of premium channels. The SCC converts one mid-band channel to Pay TV and allows for fine tuning of "premium" viewing.

All Oak units are housed in attractive, compact cabinets with leatherette-type finish, and are manufactured in Oak-owned facilities.

Our knowledgeable field engineers will help you decide which approach, and which terminal type, is most appropriate to the needs and profitability of your system. For literature or technical advice, call the Oak CATV Division today, or your nearest Oak sales office.



ECONO-CODE
Single Channel Converter-Decoder
Increases revenue in 12-channel or other non-converter systems. Oak provides scrambler and modulator for headend control of video scrambling. Two-position switch allows selection of standard or premium channel.

SCC
Single Channel Converter
Adds a channel for subscription Pay TV by converting one mid-band channel to Channel 3 or 4 utilizing a mid-band modulator. Simple to connect, simple to use; two-position switch selects standard or premium channel.

MULTI-CODE
Multi-Channel Converter-Decoder
Decodes channels specified by the system operator for secure scrambling. Incorporates an Oak Jewel Case AFC remote or Trimline AFC varactor converter to provide basic converter functions. Economical scrambler and modulator are provided for headend control of video scrambling.

OAK Industries Inc.
CATV DIVISION/CRYSTAL LAKE, ILLINOIS 60014
Telephone: 815-459-5000 ■ TWX: 910-634-3353

CATJ

MAR. 1977

VOLUME 4 – NUMBER 3

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

OFFICES

CATA/CATJ
4209 NW 23rd, Suite 106
Oklahoma City, Oklahoma 73107
(405) 947-7664

CATJ subscription rates $12.00 per year for non-CATA members, $8.00 per year for CATA member-systems; $9.00 per year for industry employed personnel for at-home delivery. In Canada, $13.00 per year for CATV systems, $10.00 per year for system employees. Foreign rates upon request.

Third class postage rates paid in Oklahoma City, Oklahoma, U.S.A.

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

– CONTENTS –

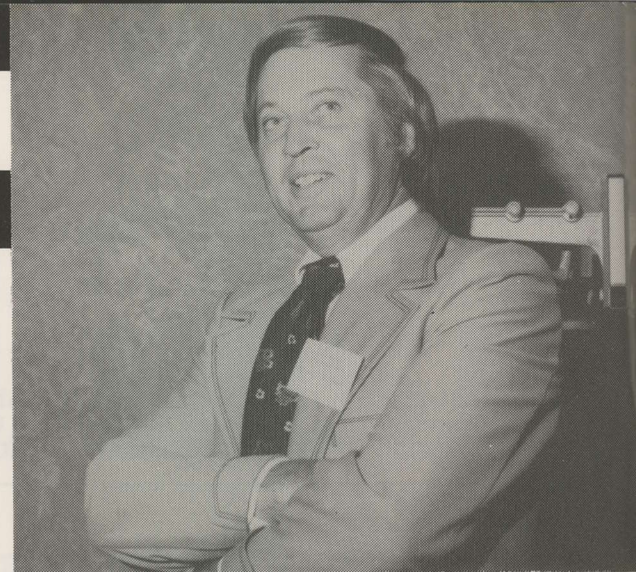
A SPECIAL ISSUE-LONG LOOK AT THE UNIQUE PROGLEMS ASSOCIATED WITH SERVING RURAL AREAS WITH CATV SERVICE

DEPARTMENTS

OUR COVER

The FCC has finally dropped a shoe, freeing up from 'most' burdensome regulation small CATV systems with fewer than 500 subscribers. It is a start. See CATA-Torial, page 4.

CATA ~ TORIAL



KYLE D. MOORE, President of CATA, Inc.

PROLOGUE:

On March 10 the Federal Communications Commission voted 7-0 to free small CATV systems (with 499 subscribers or less) **from burdensome rules and regulations. Under the new FCC ruling, systems with fewer than 500 subscribers will file one initial time in depth with the Commission** (at time of start-up for new systems, one time around **(prior to May 1st)** for grandfathered systems) **and then "verify" the facts on an FCC computer questionnaire on an annual basis. Under the new ruling, systems with under 500 subscribers will be free to carry ANY signals they can receive, provided only that they also carry any "must-carry" (typically Grade B or significantly viewed) signals. Under the new ruling, systems with fewer than 500 subscribers will NOT be required to make ANNUAL technical measurements, although they will be required to operate the systems** "according to FCC standards" **and be prepared to "show compliance" if the FCC requests that tests be made. Additionally, systems between 500 and 999 subscribers may also get this new freedom PROVIDED a new FCC proposed rule making** (to be released within weeks) **is acted upon favorably by the Commission late this spring or summer. CATA has filed a Petition with the FCC requesting that** until the FCC **determines whether the new "exemption" number shall be** 500 or 1,000, **that all grandfathered systems NOW required to file CAC applications by May 1st be granted a further extension of time to file. Full details are in the CATA NEWSLETTER for March (1977).**

Getting Waltzed Around By Bureaucracy

Several years ago the FCC said it was going to re-look at what constituted a CATV system, for regulatory purposes. In fact, as far back as 1973 there were FCC staff level inquiries into whether or not the ill-fated March 1972 rules which proclaimed that any system with 50 or more subscribers would come under FCC jurisdiction were logical or not.

The FCC has maintained there are two primary reasons for regulating cable; **their paramount reason** has been our potential to impact upon the economic viability of over-the-air broadcasting stations. That was the **whole** reason the FCC moved into cable TV following the late 60's court decision involving the San Diego area systems. The court very narrowly allowed the FCC to regulate cable where there was the "potential" that cable **might** harm broadcast economics. "Over the air television must be preserved" the court indicated.

From that narrow court decision the 1972 rules were created. They carry far beyond "economic impact" on broadcasting of course, dealing with everything from the way we hire people to the way we make our channels available to any kook who walks in off the street with a dirty videotape to show on our public access channel. Left to our own decision making processes, we would undoubtedly hire any qualified people we could find (personnel being in short supply anyhow) and most of us would give the kook with the videotape a swift kick towards the front door.

But alas our businesses are not ours to run anymore; the FCC's bureaucracy has seen to that. Still, even a bureaucracy sometimes bites off more than it can comfortably handle and the small, independent operators have been making it tough on these people since 1972. So it is understandable that at least a major portion of the FCC's cable bureau wants out of the regulatory business for the small systems and they are apparently joined in this desire by at least some if not a majority of the seven ruling Commissioners.

Now the FCC got serious about re-defining who will and won't be directly under their thumb early this past fall. The "press" has been filled with prognostications that any day or "next week" the decision would be made. It has been that way for months and months and months. What seemed to be hanging up the decision at the end was settling on a number. At one point early in the winter Chairman Wiley was pushing for the cut-off number to be 1,000 subscribers and the cable bureau was right there along side pushing the same number. But the broadcast bureau saw it from a different point of view. **They** were actually very happy with the 50 number as it stood, and here they saw an opportunity to effectuate a "compromise". And so the tug of war went, back and forth, for weeks and then months on end.

As the month's rolled by the people who would be relieved of the FCC's dictums found they were coming up on a "do or die" date; March 1st. That was the date when **all** of the grandfathered systems were **supposed to have on file** official and formal "Certificate of Compliance" applications at the Commission. In other words, March 1st was the date when everyone was supposed to be registered with the "feds". But as the definition matter dragged closer and closer to March 1st, it became apparent that many systems would be forced to prepare the lengthy and probably expensive CAC applications even though days or weeks after they did so they would have been relieved of some or all of the obligation to do so. In other words, it appeared that many hundreds (if not several thousand) systems would be making filings with the Commission, only to later learn that they **could have been** spared the whole time consuming, expensive process had the FCC simply finalized the system definition business a few weeks earlier.

That was the point, in January, where the CATA Board of Directors instructed our General Counsel to file a Petition with the Commission requesting that the March 1st filing day be delayed, "at least until the system definition docket is settled". **By some wondrous process, the Commission actually approved this CATA petition and so the March 1st date became a May 1st date.**

And still the tug of war over numbers continued. One is apt to ask why.

Recall if you will that the FCC got into our act because we **were** a threat (the FCC said) to the economic viability of over-the-air telecasting. In particular, we were capable of importing distant signals into the backyard of operating telecasters. For this "capability" we were saddled with something called non-duplication protection in the late 60's. But hark. . .back some time ago the FCC had re-visited non-duplication protection, and it found that **if** we were **smaller than** 1,000 subscribers, **no matter where we might be located,** we did **not** have to provide non-duplication protection anyhow.

In a nutshell, if we were small, we were no threat to over-the-air telecasting. And small meant below 1,000 subscribers.

So in a sense the FCC's decision as to **which** systems to let off the hook was made for them sometime ago. Those systems with fewer than 1,000 subscribers had been found not to be a "threat" to over-the-air telecasting. . .and so it followed that if we were no threat, we needed no FCC regulation.

But the bureaucracy saw it differently. They had their claws firmly implanted in our flesh, and they didn't want to let go. At least not completely. No matter that the original court-backed rationale had been disposed of at an earlier date. That only suggested that some staff people needed to get together to find some **new** rationale for staying in **our** business.

In the whole process the **reason** for regulating us in 1972 has been conveniently forgotten. We weren't an economic threat in 1972. . .but it took them several years to see that we weren't. Having disposed of that rationale, **now** we **need to be** regulated because it is "in the public interest" to tell us **who** to hire, **how much** signal to supply to our customers and **when** we should fill out forms.

The FCC **broadcast bureau,** which should have gotten totally out of **our** business with the disposal some time ago of **our** economic threat (we recognize that the broadcast bureau must be **expected** to watch out for the broadcaster's interests) is **still** in there messing around with our future. One would think that when there is support for deregulation for cable systems below the 1,000 subscriber mark **from the Chairman** of the Commission **and the full cable television bureau** that this would have been sufficient to get the matter so resolved. To have the matter compromised down to 500 subscribers at this time is an insult to common sense. It is a sorry state of affairs when people feel they **must** compromise at **every** turn, simply because compromise is an accepted way of life in a bureaucracy. **Even the rationale for compromise has been forgotten.**

"The spirit of compromise" has become a way of life at the FCC. The broadcast bureau seems to feel it **must oppose** any changes for cable that mean a better cable environment. . .simply because it is **"the"** broadcast bureau. No "bureau" should be this controlled or manipulated by those it is supposed to regulate. **The broadcast bureau is a sorry lot and the sooner somebody gets some backbone and knocks some heads together over there the better off the world will be.**

A Refreshed Commitment to Leadership

The cable industry knows that Jerrold was a pioneer in cable TV technology and is the largest supplier of equipment. Jerrold Electronics began operation in 1948, over 28 years ago.

Jerrold over-expanded, as did most of the industry in the heady days of the early 1970's, in anticipation of forecasted industry growth and the leaping ambition of some of our customers. When the industrywide systems building drop occurred, neither Jerrold management nor its parent General Instrument reacted immediately, or, in hindsight, adequately, to the adjustment in industry growth rate in new systems investment that took place. It was perhaps a case of reluctance to conform to the new reality.

Last year, it became clear that Jerrold must change, as most successful systems operators had changed, or Jerrold would not be competitive enough—either to respond to customer needs *or* to make a satisfactory return on investment.

An action plan began last fall. The primary objectives were to reduce Jerrold's break-even and to achieve better coordination between sales and manufacturing operations and thus improve customer services.

Decisions were made to establish a group management headquarters at Chicopee, Massachusetts, where Jerrold's largest factory operation is located, and, in parallel, to move manufacturing functions from the Horsham, Pennsylvania, location to Chicopee to reduce duplicate overhead, shorten lines of communication, and improve systems and supervision.

The Horsham geographic area will continue to be the center for product development, engineering, and sales, but Jerrold's present oversized Horsham facility will be sold and personnel will be moved to a smaller facility in that area.

The plan called for the addition of several senior personnel for specialized functions in which the Jerrold organization needs more strength; they are mostly in place.

Negotiations began with a national distributor that maintains five regional warehouse locations with the goal of greatly improving Jerrold's effectiveness in shipping small orders more rapidly and reliably, while relieving the factories of burdensome and costly "short runs." With this arrangement, the national field sales organization will be supplemented by technical specialists to extend new product understanding and provide customer feedback.

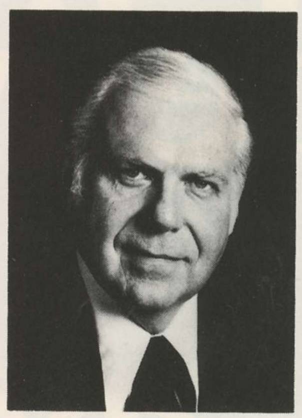
I would like to emphasize here that Jerrold moves to reduce break-even do not indicate any intention to reduce product development investment or customer service. QUITE TO THE CONTRARY. Jerrold will continue to maintain by far the industry's largest research and engineering activity. Jerrold is concentrating on improvement in customer service as never before in recent years.

We *have* recognized that the Jerrold organization must become more productive and cut fat.

We are convinced that the future of this industry is bright. New systems building has begun to expand again, because of the greatly improved financial condition of our customers and the changed economic outlook. Pay TV has given the industry a new vitality.

George Safiol became our company's Senior Vice President for Broadband Communications, worldwide, on October 1, 1976. When you meet George you will understand another reason we are optimistic about our future in the CATV industry. George has had a brilliant six-year record with General Instrument. He is a professional and a winner.

We believe a new era has begun in the cable television industry, and that Jerrold will meet its challenges.



Frank G. Hickey

Chairman and
Chief Executive

JERROLD ELECTRONICS
GENERAL INSTRUMENT CORPORATION

Can You Build For $500 Per Mile?

SERVING RURAL AREAS WITH DENSITIES OF TEN HOMES PER MILE WITH CATV

Max/Min

Last fall, in the middle of November, the **Office of Technology Assessment** convened a Conference on Communications (in) Rural America. The session was well attended by approximately 200 people who felt they had something to contribute to the problems posed by this conference. OTA is one of those little known and seldom heard-from federal creations that in this case is charged with the responsibility of keeping tabs on "technological developments" and then creating "white papers" for the U.S. Congress to study. The conferees broke into three separate panels to deal for three days with such diverse subjects as (panel 1) 'Rural Development and Communications', (panel 2) 'Technology, Economics and Services' and (panel 3) 'Federal Policy'.

The thrust of the conference was largely cable television. "Could" the conferees asked themselves and one another "cable television be expanded into rural areas so that rural, isolated Americans could enjoy the 'benefits and advantages' of multiple sources of communications?" The question was probably not answered during the three days the meet lasted.

The conference did, however, put some wheels into motion at CATJ; wheels that have sporadically moved from time to time during the past four years, but which had not in the past ever moved far enough to be worthwhile to the industry. In this case the impetus of the OTA conference may well have provided the information that follows.

Can cable be extended into rural areas? What are the limitations? Are they largely financial (i.e. not enough subscribers per mile)? Or are they largely technological (i.e. inadequate equipment for the job)? Or, alternately, are the problems largely created by burdensome regulation (i.e. do existing FCC regulations restrict the type of low-cost or cost-effective cable delivery systems which would have to be employed in rural areas)?

In this special "Rural Cable Issue" of CATJ, we look at what is being done in various segments of the United States at several levels. By people who have not been **told** that they 'cannot do this or that' and by people **who are building and operating cable systems,** profitably, **with as few as 10 cable subscribers per mile.**

The work reported on here is being largely if not totally done by "do-it-yourselfers"; people who do their own construction, and often **build** their own equipment. That's right. . .people who sit down at the work bench with a handful of parts and some 'smarts' to build not only their amplifiers but their antennas, their pre-amplifiers, their bandpass filters and traps. . .essentially everything that is required to make a cable system work, with the possible exception of the cable itself and the fittings.

In a nutshell, these are people who are setting out to create **"maximum benefits for minimum investment".** Most figure their initial time devoted to constructing the cable system equipment and the plant "is not chargeable". In other words, their total cost for a new plant or segment of a plant is the equipment itself. And by building all or most of that, they whittle down the costs of cable system installation to unheard of low levels. **Numbers like $500 per mile, installed, are not uncommon.**

Our look is broken into two separate segments; we will be looking first at a man in Arizona who operates "a number of" CATV systems scattered throughout Arizona, New Mexico and elsewhere. His total number of subscribers is nobody's business. . .but we assure you it is not inconsequential.

Swan/Bisbee

Oliver W. Swan has been kicking around the television receiving business for a long time. Swan began in Stockton, California in the early 50's, installing television antennas in what was then a fringe market from San Francisco transmitters. In 1953 Oliver Swan developed an interesting 'new' form of antenna, which he called the "Swan Bandpass Antenna". Swan decided that one way to get good **in-channel** response from a yagi type of antenna was to utilize multiple driven elements for the channel, phasing or "stacking" them in such a way that the combined net effect of the multiple driven elements was to cover **all** of a channel with "peak response". Swan's antenna was produced in modest quanities in Stockton for approximately ten years, and other versions developed including a low band (broad banded) and high band (broad banded) version. Swan also developed a line of amateur radio and other VHF-UHF frequency region antennas and some years back decided to retire 'south' to southern Arizona. In that process he spun off his antenna line to an outfit in the Bay Area which today manufactures amateur and other antennas under the 'KLM Electronics' line. KLM (Swan) antennas are well respected in the circles they are sold and in the amateur VHF-UHF communications field the KLM antennas are just about the hottest things going.

Swan soon found 'retirement' confining, and he began 'playing with' small master antenna systems in and around southern Arizona. In addition to being a very capable 'antenna design man', his years of experience in installing fringe area antenna systems in northern California equipped him for finding television in remote canyons and arroyos in the parched southwest. Believe it or not, there are **still** many remote small communities scattered throughout Arizona, New Mexico, western Texas and northern Mexico where television reception is at best a fleeting thing. And as people sought Swan out to install antennas for them, small CATV systems just kind of happened. Which set Swan to thinking about the costs involved. Not afraid of breaking out a soldering iron, a box of parts and some G-10 circuit board, Swan began to systematically develop a line of CATV equipment **for his own use.** His whole intent was and remains today to **provide himself** with equipment to construct small systems. He has been doing this long enough now that his experience is worth sharing with others who may have similar abilities or inclinations. In a nutshell, hundreds of Swan designed and produced CATV-type amplifiers, filters, traps and antennas have been providing faithful service for many years, and because Oliver Swan is willing to share his design information with others, we are able to in turn put it into printed form.

Seat Of The Pants

Swan has constructed so many hundreds of CATV units on his own work bench that his approach to 'throwing together' a mainline amplifier is extremely casual. That kind of casualness comes only with confidence and confidence comes only with experience. In other words, there is no substitute for doing it yourself enough times that you work out in your own mind what will and will not work, and then having found the magic combination, repeat it again and again with dispatch.

Swan notes **"Designing and building a do-it-yourself CATV system with ten or fewer cable customers per mile, that will pay off in three years or less, is quite a challenge. But it can be done, and has been done, and will be done again."** Swan makes the point that small, rural systems are not unlike bigger, more suburban systems. **"No two are alike, and where one set of traps or filters or one combination of antennas and mixing may prove satisfactory for one system, the next system will present unique differences to which the system designer must adapt."** Again, there is and can be no substitute for experience.

"Anyone building equipment must... absolutely must...have an adequate sweep generator plus detector and display and a good marker system. There is no way you can align equipment, or make performance checks on a periodic basis, unless you have at least some shop quality test equipment". The point is well taken, and there is a caveat or warning here for the do-it-yourselfer who might want to duplicate Swan's detailed step by step instructions here without nothing more elaborate than a field strength meter.

Don't do it.

There are good quality, low cost sweep and display systems available now. Advertisements for such systems are found in many issues of CATJ. Have an adequate sweep/detector/display/marker set up on your bench **before** you start out to shave new plant construction costs by building your own equipment.

Finding The Signal

"It may seem awfully elementary to say this... but before you can build a CATV system, you have got to find some signal" remarks Swan. **"I learned in the 50's in California that signal is truly where you find it and I cannot emphasize strongly enough that the prospective CATV headend must be located where the maximum signals are. In the southwest where we have single and multiple knife-edge refraction paths, the signal levels can vary 20-30 dB in a matter of feet."**

Swan mounts a test antenna on a pick up truck and drives through all of the available area several times before he selects a headend site. **"Finding 10 dB more signal off-the-air has a very direct bearing on the success or failure of the prospective system. Not only does it reduce the cost of the system headend, but it also reduces maintenance on otherwise larger antenna arrays, and it provides margins for fades and equipment degradation".** Swan knows what he is talking about...people **should** spend more time planning and looking and less time promoting. **"I don't have to promote my systems, simply because the pictures and channels promote themselves. I'd rather spend an extra two weeks finding really good quality signals, going in, than spending two years trying to 'sell people' on hooking onto the cable. Good pictures sell themselves. Bad pictures require hot-shot marketing techniques".** Swan comes from the old, often forgotten, school of CATV engineering. His words ring true today however.

"Too many new system builders are too anxious to get the system built. They cut short the planning time **and** signal searching time **in their rush to get signals dumped into the cable. They pay for that short sightedness for years and years thereafter, by reducing cash flow, increased maintenance and increased service calls. If I had my way, every one of my new systems would** 'cook in' **with off-air signal tests for six months to a year** before **the system was built. People should spend less time worrying about getting a good deal on five acres of land behind some farmer's barn and more time worrying about whether there are strong, reliable, quality signals available there."**

Swan doesn't rent or lease land as a rule. He exchanges one free TV hookup, for the land owners home, for the use of the land. In the southwest it works because there is no TV or very poor TV without someone like Swan doing the work.

In Swan's example system (diagram 'A') we have a not untypical site-topography situation. The signals arrive at the brush-land site via a combination of knife-edge refraction and ground reflections. **"In this situation the best signals from channels 3 and 5** (190 miles distant) **were found at heights between 28 and 38 feet above ground. Channels 8, 10 and 12 were found in the same area, some 175 feet away along a horizontal line, at heights from 18 to 26 feet above ground."**

The width of the illuminated area for channels 3 and 5 was only 25 feet, while the width of the illuminated area for channels 8, 10 and 12 was 17 feet.

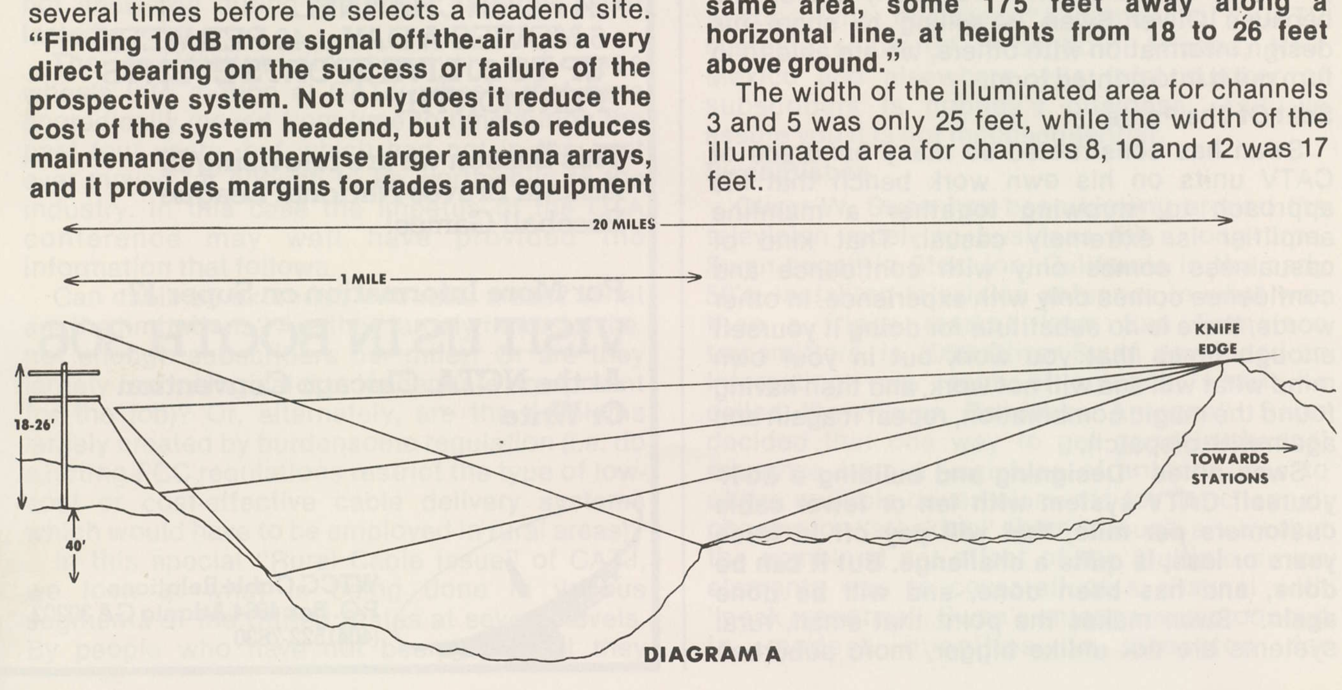


DIAGRAM A

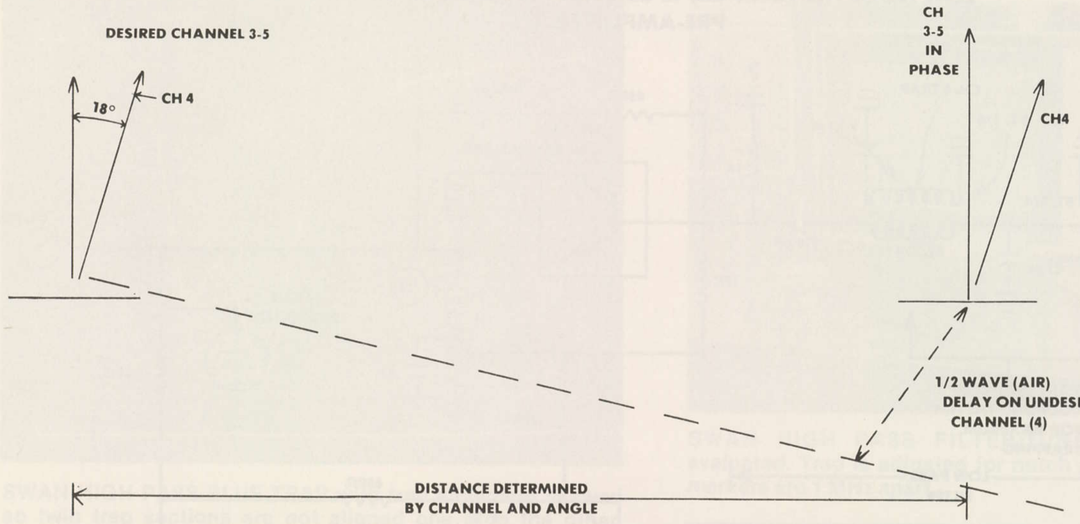


DIAGRAM B

"The signals arrive at this site via a series of three separate knife-edge refractions; the first from the receive site is some 20 miles; the next is approximately 70 miles distant (still 120 miles from the stations) **while the third is 100 miles from the receive site** (90 miles from the stations)." A combination of knowing where to look, and how to look, is obviously important (see CATJ for June 1976; page 35).

"The antenna is located on the edge of a small rise (40 feet high) **overlooking a small valley about a mile across"** (diagram A). The signal strengths found were:

(1) Channel 3 .... 20 microvolts
(2) Channel 5 .... 30 microvolts
(3) Channel 8 .... 15 microvolts
(4) Channel 10 .... 15 microvolts
(5) Channel 12 .... 20 microvolts

These are levels from a test antenna (**not** a dipole).

At the same site, with no particular difficulty, additional second-market signals were found on channels 4, 6, 9 and 13. They fell between 2,000 and 3,000 microvolts. The five distant channels (3, 5, 8, 10 and 12) were very stable off the air (plus or minus 5 microvolt typical variation long term) due to the knife-edge refraction path technique employed. **"The electronic engineer has yet to develop an AGC system that is as stable as a good knife edge path"** comments Swan.

The wide range of levels present some problems of course; which is what part of this exercise is all about; curing those problems. The object for this system is to provide nine channels of television (plus 16 channels of FM), balanced, to the subscriber homes. The total off-air level ranges were as follows:

Desired Distant Level	Troublesome Level
Channel 3 -34 dBmV	Channel 4 +6 dBmV
5 -31 dBmV	6 +4 dBmV
8 -36 dBmV	9 +6 dBmV
10 -36 dBmV	(9 +6 dBmV)
12 -34 dBmV	13 +8 dBmV

As Swan notes **"Divergent levels like this will separate the men from the boys in short order!"**

Four of Swan's bandpass antennas were designed into the headend for channels 3 and 5. They are the ten element jobs, stacked two high by two wide; 10 foot separation between the vertical stacks and 14 foot separation between the horizontal stacks. The bearing to the respective 'markets' is 18 degrees apart so the horizontal separation is selected to place a null towards the troublesome channel 4 and 6 transmitters (see CATJ, page 7 for June 1974). See diagram B.

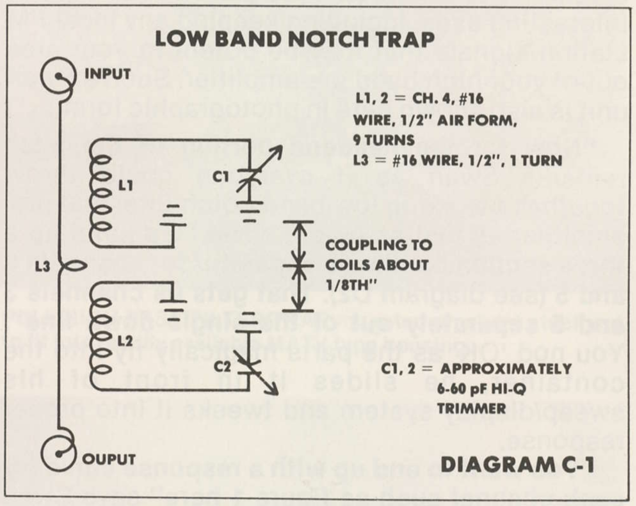


DIAGRAM C-1

"The antenna equipment consists of the antenna array (stacked so as to reduce the channel 4 and 6 levels on the 3 and 5 antenna array), **plus a notch filter for channel** 4 picture/6 picture (see diagram C1) **and a low noise antenna mounted pre-amplifier. The pre-amplifier has 12 dB of gain and a noise figure between 1.5 and 1.7 dB"** notes Swan. **It also** includes a built-in notch trap for channels 4 (picture) and 6 (picture) carriers. **"Remember that no two headend sites are the same, so the guy that rolls his own is in a position to design his particular headend gear to his exact site requirements. I think that may be an advantage that an off-the-shelf buyer may not have"** notes Swan. The low-noise low band pre-amp is shown in diagram D.

(A high band unit which is a combination high-

LOW NOISE (1.5 TO 1.7 dB) 12 dB GAIN ANTENNA MOUNTING PRE-AMPLIFIER

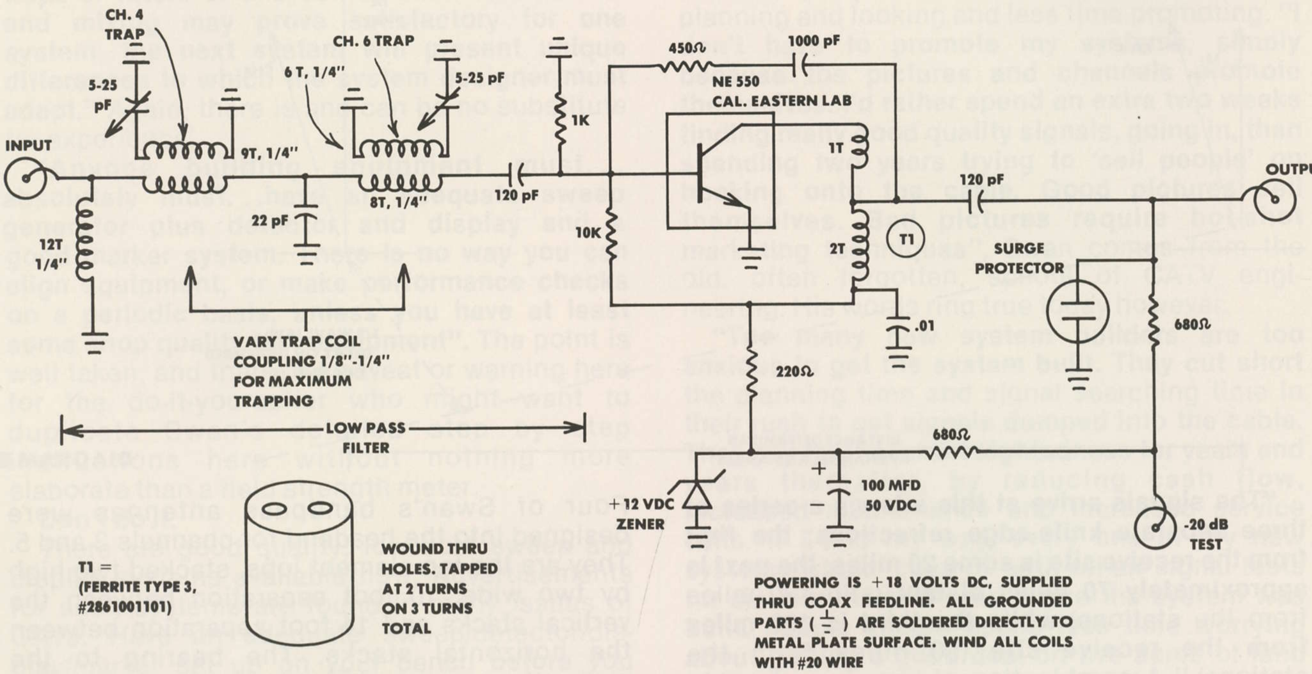


DIAGRAM D

pass filter [passing only the high band region] and a tuneable notch trap is also shown as diagram C-2. The high pass portion has several interesting uses, including keeping any local FM station signals that may be potent in your area out-of your high band pre-amplifier. Such a Swan unit is also shown here in photographic form.)

"Now for the headend portion of the site" remarks Swan as if everyone could throw together a working low band notch filter and pre-amplifier as fast as he did. **"Next we build up a three section bandpass separator for channels 3 and 5** (see diagram D2). **That gets us channels 3 and 5 separately out of the single down line".** You nod 'OK' as the parts magically fly into the container, he slides it in front of his sweep/display system and tweeks it into proper response.

"You want to end up with a response curve for each channel such as figure 1 here" says Swan dryly **"not like figure 2** (downward hump in center of channel) **or not like figure 3** (too broad)."

"Then you put together a double trapped bandpass filter such as is shown in diagram D2-B. You can get the trap sections (capacitors F and coils E) **to take the nearest adjacent low band carriers down about 30 dB** (figure 5) **on low band and about 20 dB on high band** (figure 8). **When you get this far, you have the adjacent channel signals well attenuated and you are ready to amplify them with a bandpass amplifier".**

Swan's approach to a single channel voltage amplifier is shown is diagram E. This is a non-AGC'd amplifier with 24 dB of voltage gain and two active stages sandwiched around another bandpass filter stage. *(Continued Page 16)*

HIGH PASS FILTER (PASSES 130 MHz TO 220 MHz) WITH TWO NOTCH TRAPS

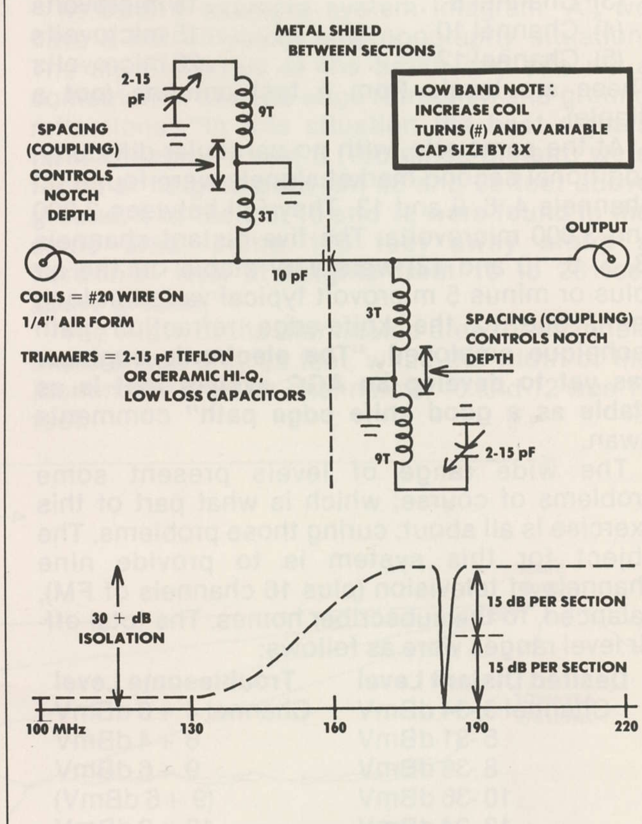
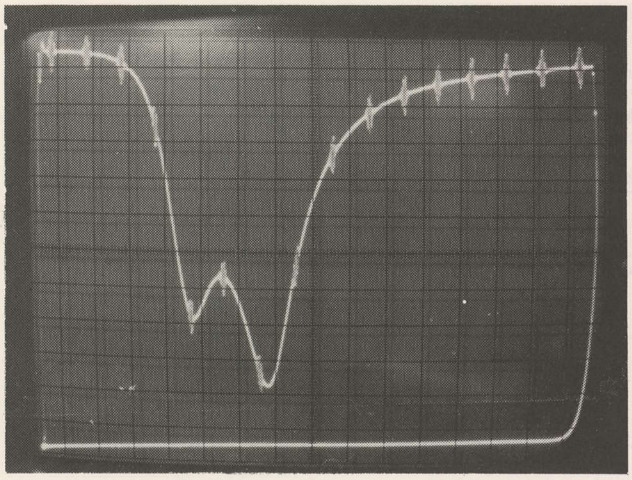
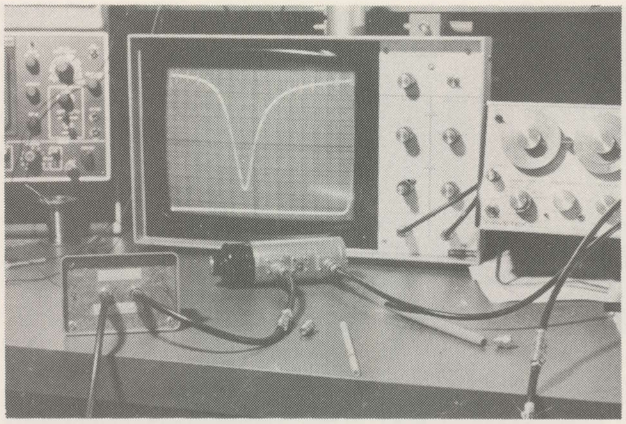


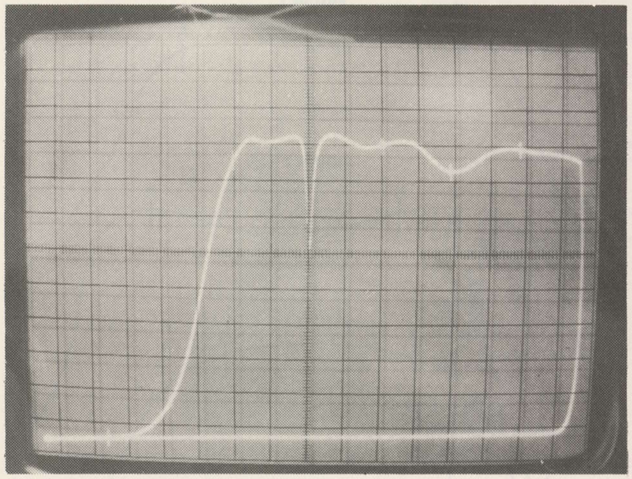
DIAGRAM C-2



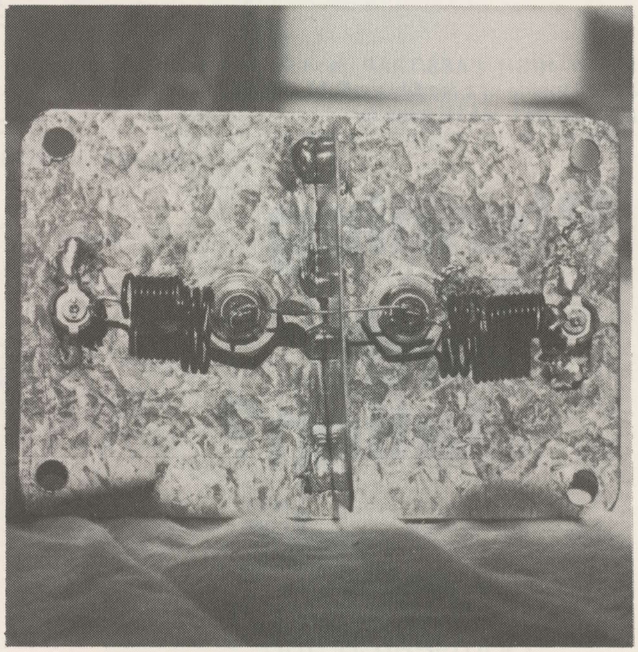
SWAN HIGH PASS PLUS TRAP with trap alignment skewed so twin trap sections are not aligned one atop the other. Frequency range center of display screen is 200 MHz and markers are at 1 MHz intervals.



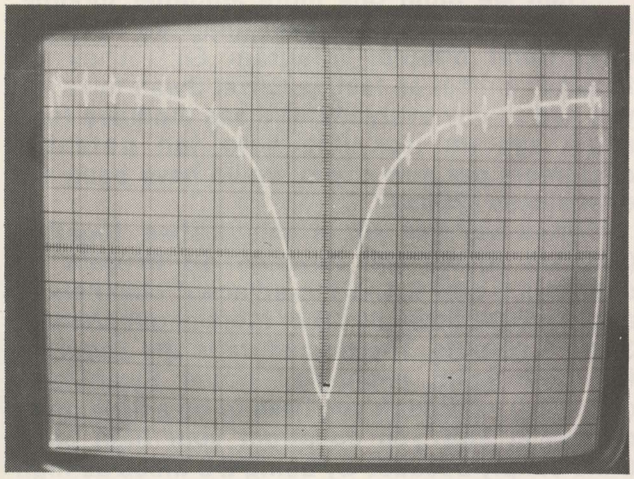
SWAN HIGH PASS FILTER/TUNEABLE TRAP being evaluated. Trap is adjusted for notch at 200 MHz in display, markers are 1 MHz apart.



HIGH PASS PLUS TRAP segment shows low insertion loss (under 0.5 dB) at 50 MHz, around 1.5 dB thru loss at 100 MHz (second marker from left), rising to approximately 35 dB of isolation at 160 MHz. Notch is at 200 MHz (trap adjusted for this frequency).



FULL HIGH PASS FILTER/TRAP mounted on sheet stock cut to fit into readily available MATV type housing.



NEAR PROPER ALIGNMENT of Swan trap section indicates 18 dB of trapping maximum at 200 MHz with approximately 10 dB of trapping +/- 1.5 MHz away from trap center frequency (1 MHz markers).

ONE HALF OF HIGH PASS FILTER/TRAP showing trap segment (right) and intra-section shield (left) with coupling capacitor feeding signal through hole in shield. Shield keeps two trap sections from inter-acting.

SWAN HIGH PASS/TRAP module has been designed to install inside of a readily available "MATV-type" housing from a well known MATV supplier.

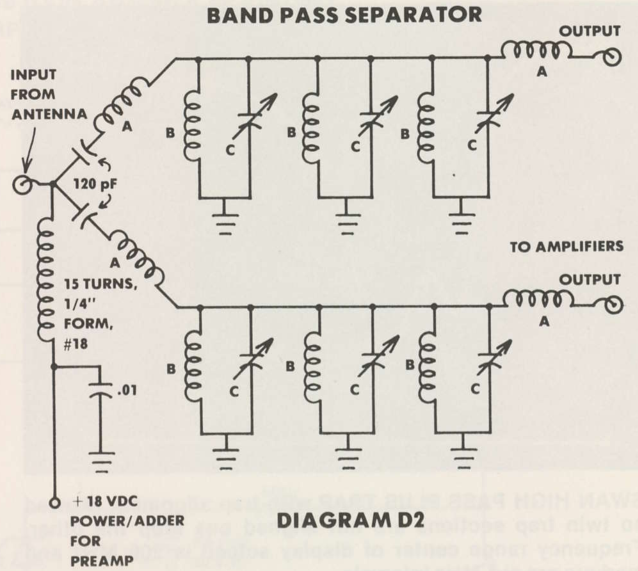


DIAGRAM D2

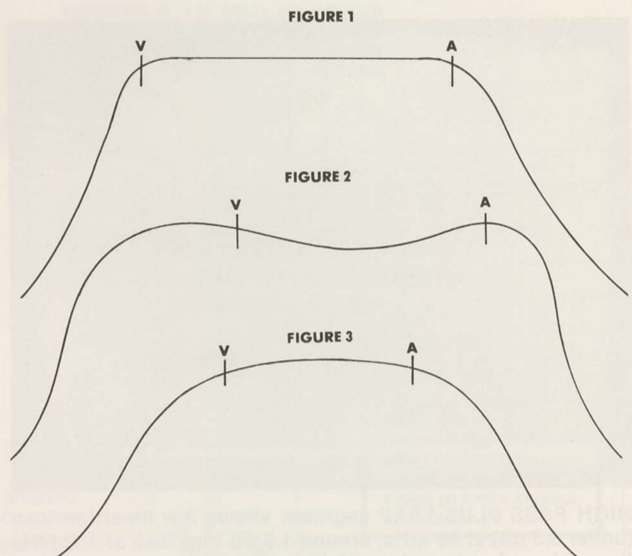


DIAGRAM D-2A

"Then we build one more amplifier module, this one with 12 dB of gain (diagram F) **and a directional coupler** (diagram G)". They go together almost as fast as Oliver Swan talks. **"If you had to buy everyone of these modules for a small system like this with ten potential customers per mile. . .you would have been out of business already".**

"When we get all of this lashed together (diagram H) **we will have 45 dB of gain on channels 3 and 5 and the adjacent channels** (4 and 6) **will be down 50 dB or more at our channel 3 and 5 outputs. The procedure is the same for the high band channels"** notes Swan (see diagram I) **"although you have to be a little more careful in how you construct your high band units simply because by being 2-3 times as high in frequency you can lose circuit 'Q' so much faster up there."**

(Continued Page 20)

BAND PASS AMPLIFIER (SINGLE CHANNEL)
[NF = 2.5 dB] [GAIN — 24 dB]

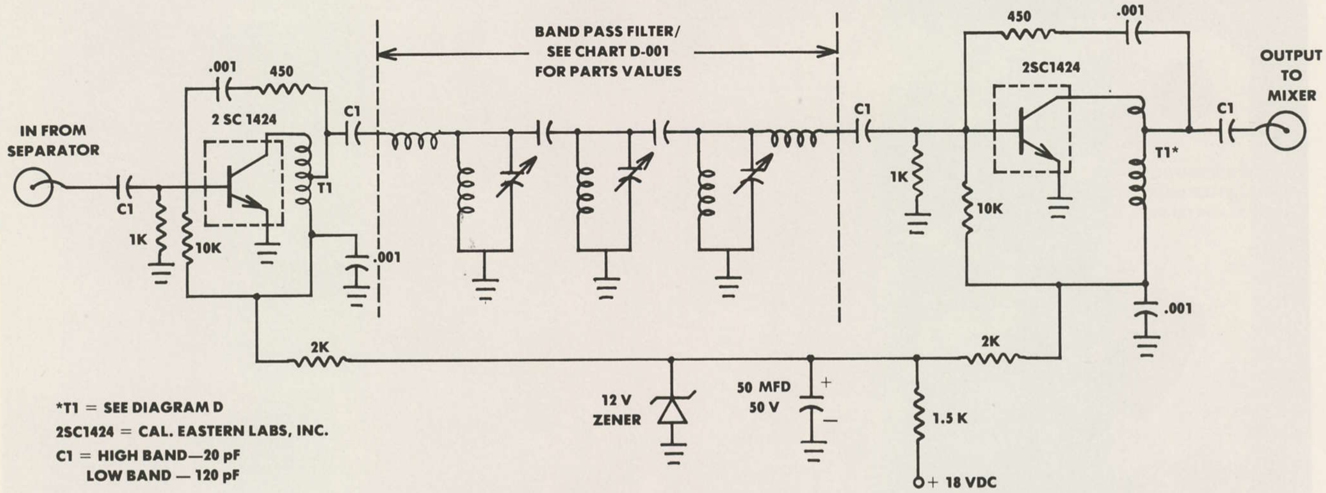


DIAGRAM E

DOUBLE TRAPPED BAND PASS FILTER

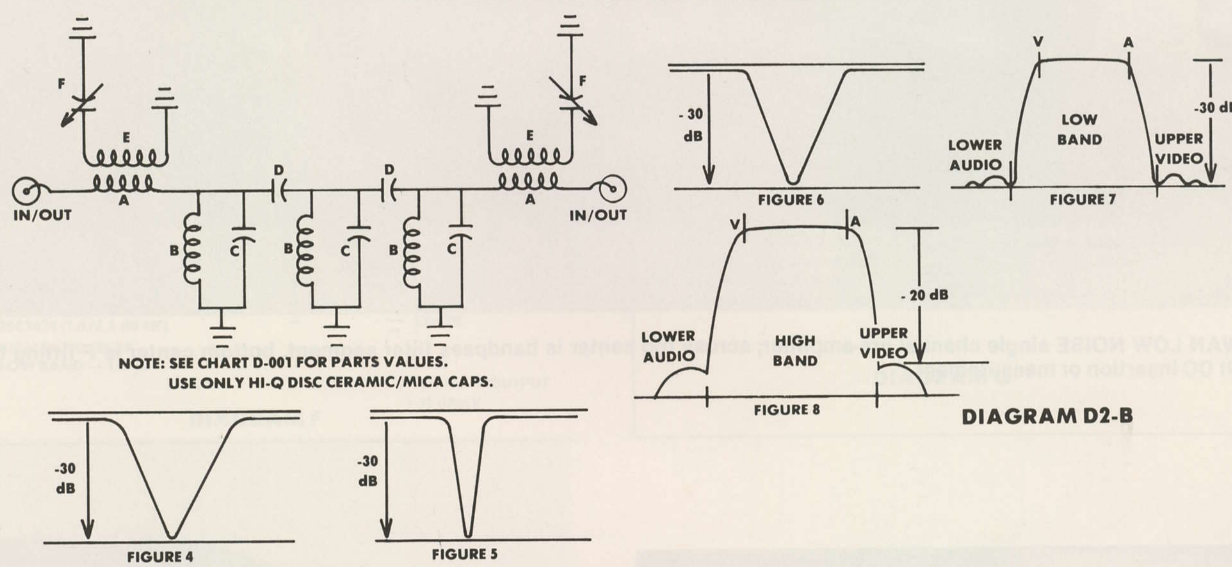
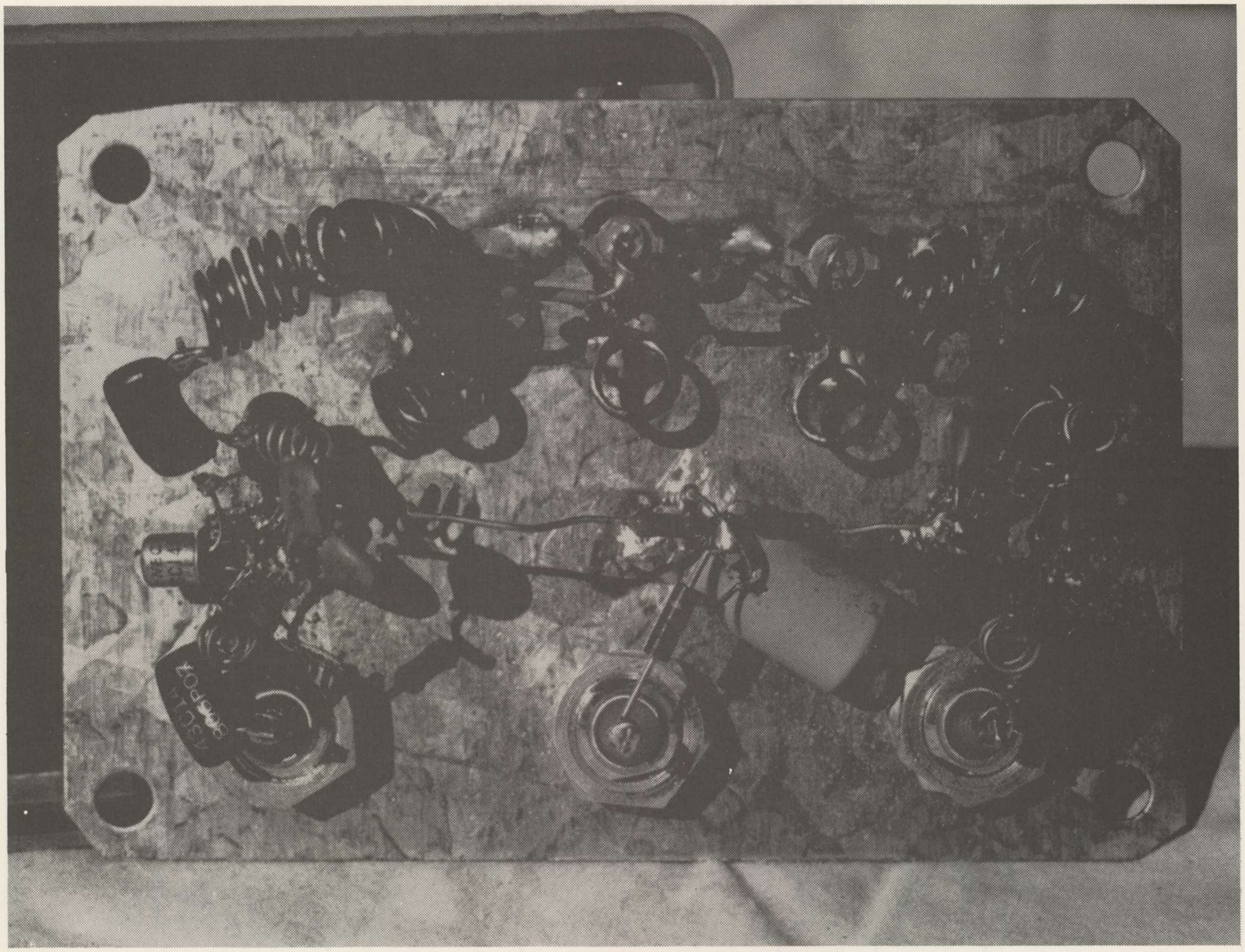


DIAGRAM D2-B

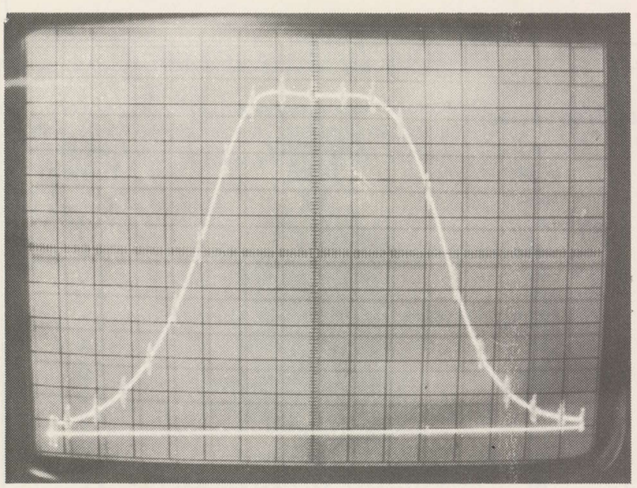
TABLE D-001 / BPF and Trap Values

Channel	Coil 'A' Turns	Coil 'B' Turns	Capacitor 'C' pF	Capacitor 'D' pF	Coil 'E' Turns
2	18	8	45	4.7	12
3	17	7	40	4	10-11
4	16	6	35	4	9
5	14	5	30	4	7-8
6	13	4	25	4	6
FM	10	6	22	4.7	9
7	12	3	15	1	4-5
8	11	3	14	1	4-5
9	10	3	13	1	4-5
10	9.5	3	12	1	4-5
11	9	3	11	1	4-5
12	8.5	3	10	1	4-5
13	8	3	10	1	4-5

NOTES: All coils are wound with number 18 wire (coated) **on 1/4 inch air form** (such as 1/4 inch drill bit). **The high band 1 pF capacitors may be constucted by twisting one turn of #18 wire** (insulated) **together loosely. See diagrams D2, D2-B and E for circuits using these values. In aligning, connect high level sweep source to input and adjust capacitor D for bandwidth and capacitor C for response pattern. Proper adjustment will have 2 dB or lower through loss on high band and 1 dB or lower through loss on low band. In diagram D2-A figure 1 is proper response; figure 2 is too much inductance** (spread coil A apart) **and figure 3 is too much capacitance** (reduce capacity in capacitor D).



SWAN LOW NOISE single channel pre-amplifier; across top center is bandpass filter segment, bottom center is F fitting for 18 volt DC insertion or measurement.



SWAN CHANNEL 8 PRE-AMP had measured gain of approximately 20 dB, flat bandpass response over 4.5 MHz segment (markers at 1 MHz intervals) and relatively steep skirts. Pre-amp includes bandpass filter between two amplification stages (see text).

SWAN SINGLE CHANNEL PRE-AMP is housed in a readily available MATV type housing using locally fabricated sheet for bottom plate. Three adjustments along bottom are for bandpass filter section.

BANDPASS FILTER SECTION OF SWAN high band (channel 8) pre-amplifier fits between input and output amplification stages (see schematic and text).

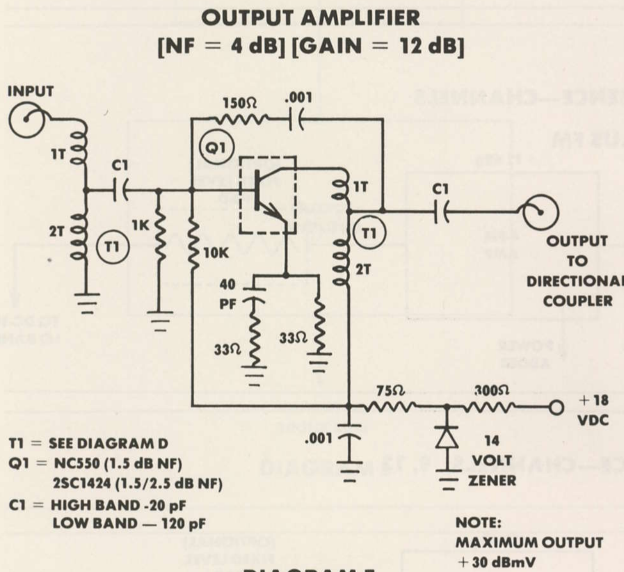
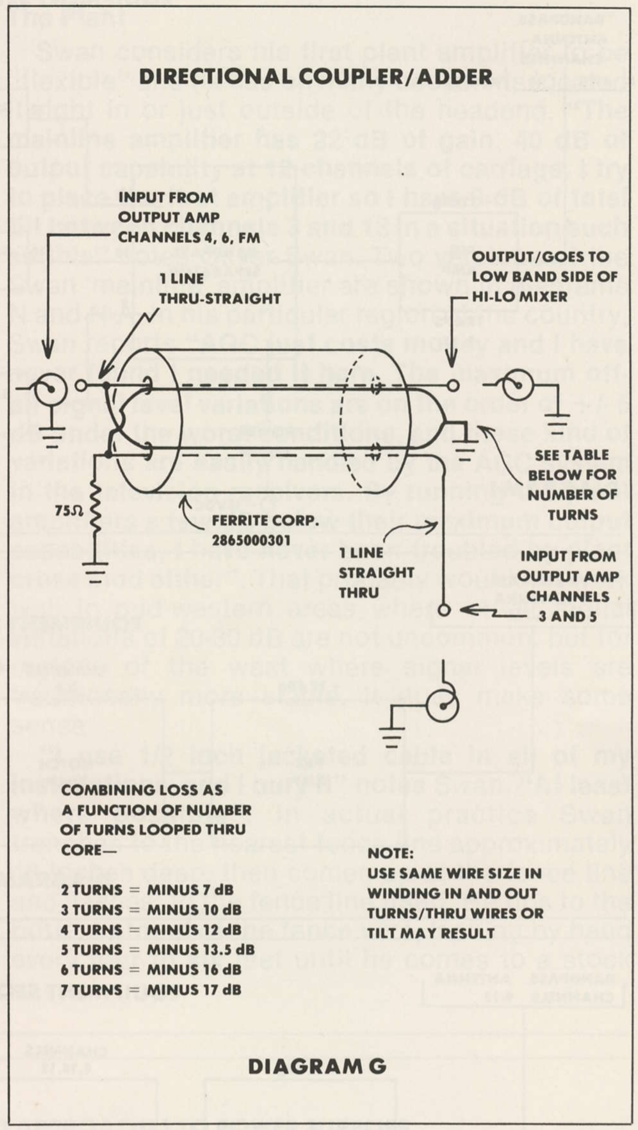


DIAGRAM F



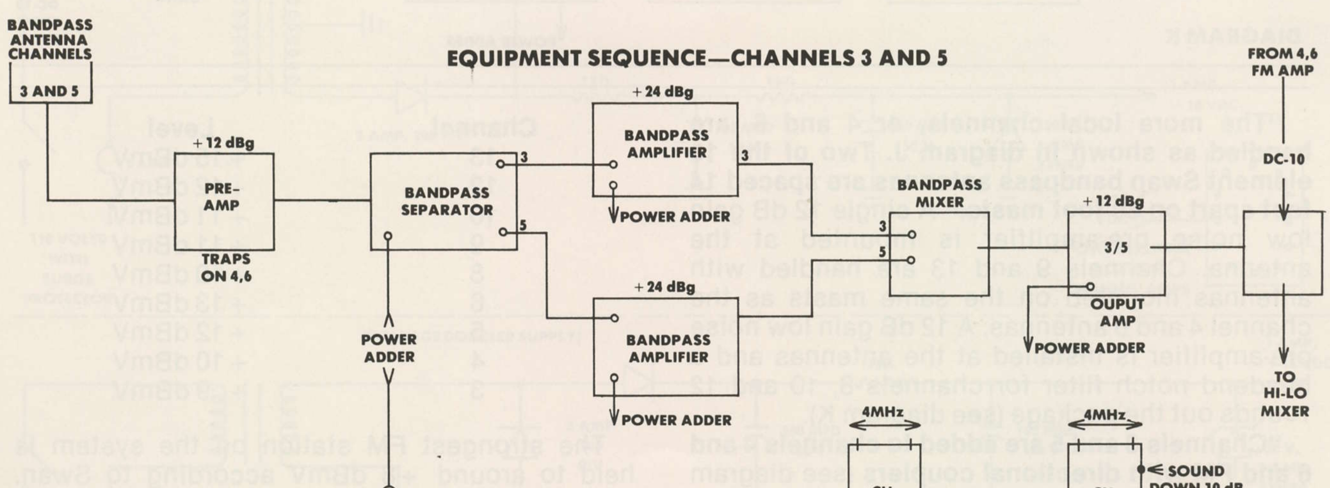


Diagram H

EQUIPMENT SEQUENCE—CHANNELS 8, 10, 12

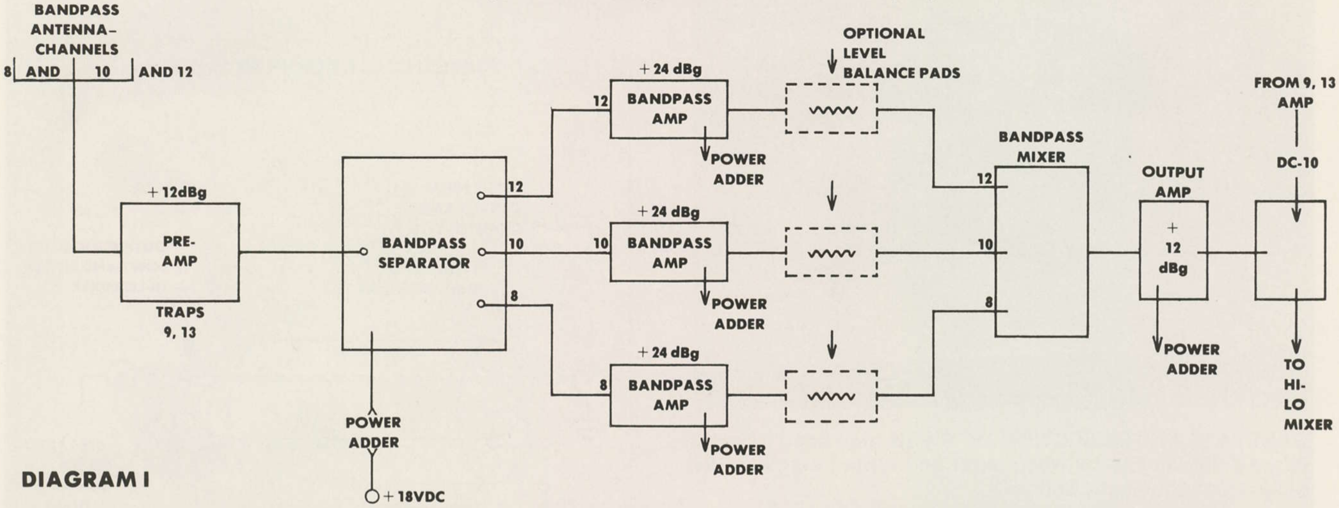


DIAGRAM I

EQUIPMENT SEQUENCE—CHANNELS 4,6 PLUS FM

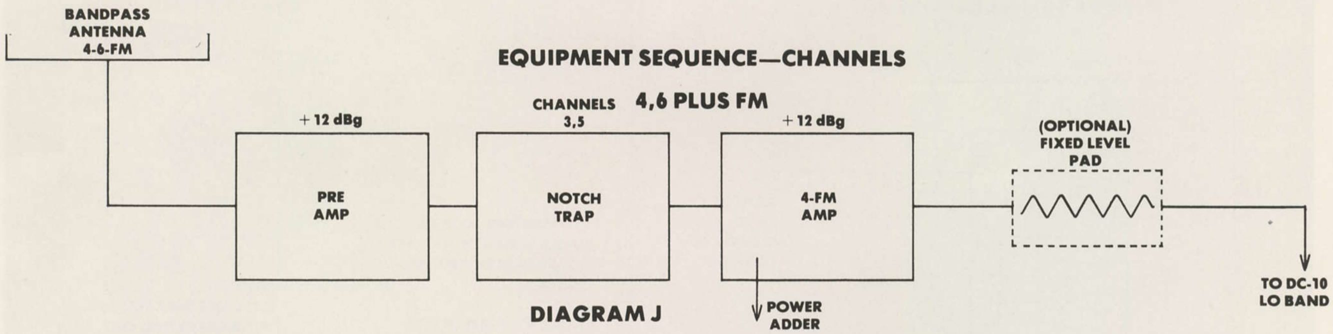


DIAGRAM J

EQUIPMENT SEQUENCE—CHANNELS 9, 13

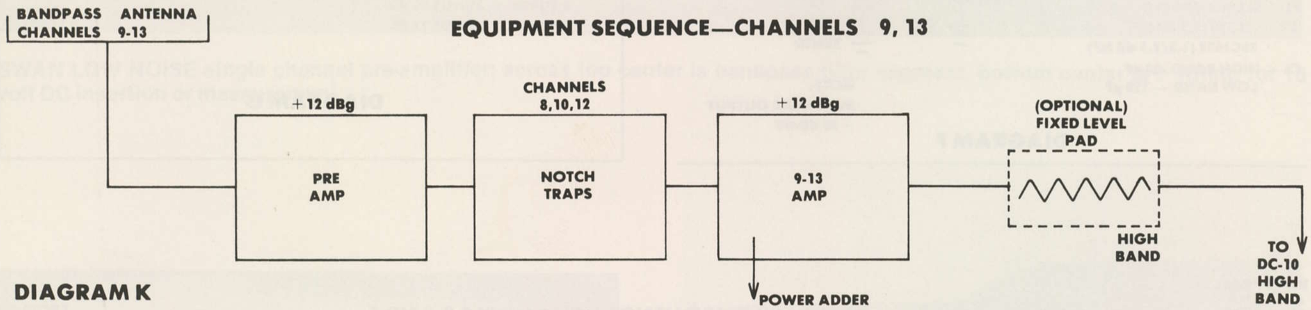


DIAGRAM K

"The more local channels, or 4 and 6, are handled as shown in diagram J. Two of the 10 element Swan bandpass antennas are spaced 14 feet apart on 30 foot masts." A single 12 dB gain low noise pre-amplifier is mounted at the antenna. Channels 9 and 13 are handled with antennas mounted on the same masts as the channel 4 and 6 antennas. A 12 dB gain low noise pre-amplifier is installed at the antennas and a headend notch filter for channels 8, 10 and 12 rounds out the package (see diagram K).

"Channels 3 and 5 are added to channels 4 and 6 and FM with directional couplers (see diagram G) **and they connect to the low side of the hi-low combiner/coupler. The channel 8, 10 and 12 signals are added to the channel 9 and 13 signals with a directional coupler and then brought to the hi side of the hi-low combiner/coupler."**

The output levels are then as follows:

Channel	Level
13	+15 dBmV
12	+12 dBmV
10	+11 dBmV
9	+11 dBmV
8	+10 dBmV
6	+13 dBmV
5	+12 dBmV
4	+10 dBmV
3	+ 9 dBmV

The strongest FM station on the system is held to around +8 dBmV according to Swan. Pads (fixed) are utilized as shown in diagrams J and K (or where needed) to put all of the trunk input levels at the proper point.

As for powering of all of the 'little boxes', diagrams L and M show how that goes together for the system.

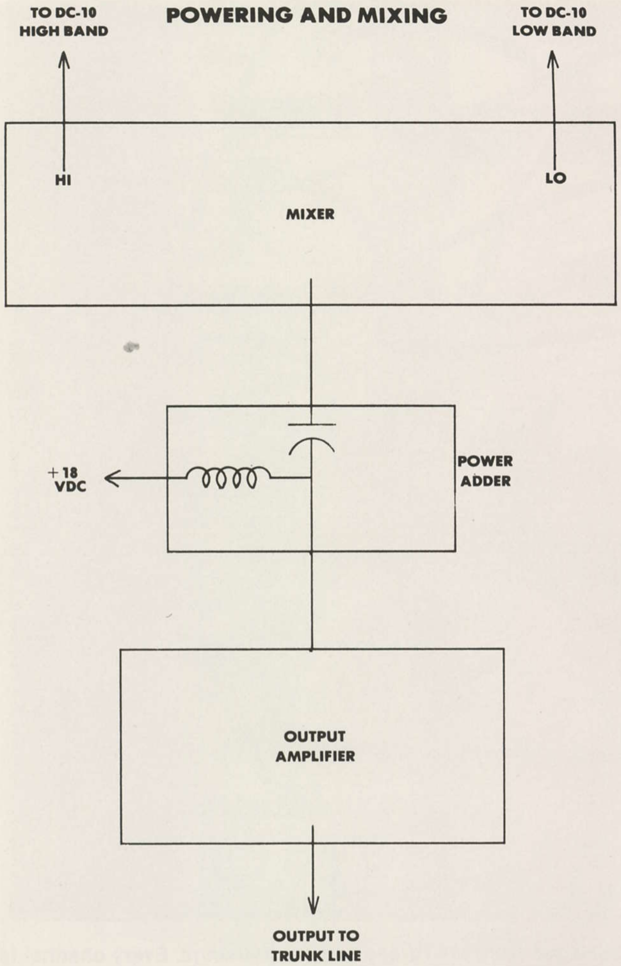


DIAGRAM L

The Plant

Swan considers his first plant amplifier to be "flexible" and he has on many occasions located it right in or just outside of the headend. **"The mainline amplifier has 22 dB of gain, 40 dB of output capability at 12 channels of carriage. I try to place the first amplifier so I have 9 dB of total tilt between channels 3 and 13 in a situation such as this"** notes Oliver Swan. Two versions of the Swan 'mainline' amplifier are shown in diagrams N and N-A. In his particular region of the country, Swan reports **"AGC just costs money and I have never found I needed it here. The maximum off-air signal level variations are on the order of +/- 5 dB under the worst conditions, and these kind of variations are easily handled by the AGC system in the television receivers. By running the plant amplifiers a few dB below their maximum output capabilities, I have never been troubled by plant cross mod either".** That probably would not work well in mid-western areas where off-air signal variations of 20-30 dB are not uncommon, but for regions of the west where signal levels are traditionally more stable, it does make some sense.

"I use 1/2 inch jacketed cable in all of my installations, and I bury it" notes Swan. **"At least where possible".** In actual practice Swan trenches to the nearest fence line approximately 18 inches deep, then comes up at the fence line and 'lashes' to the fence line itself. He ties to the bottom strand of the fence wire, lashing by hand every four to six feet until he comes to a stock

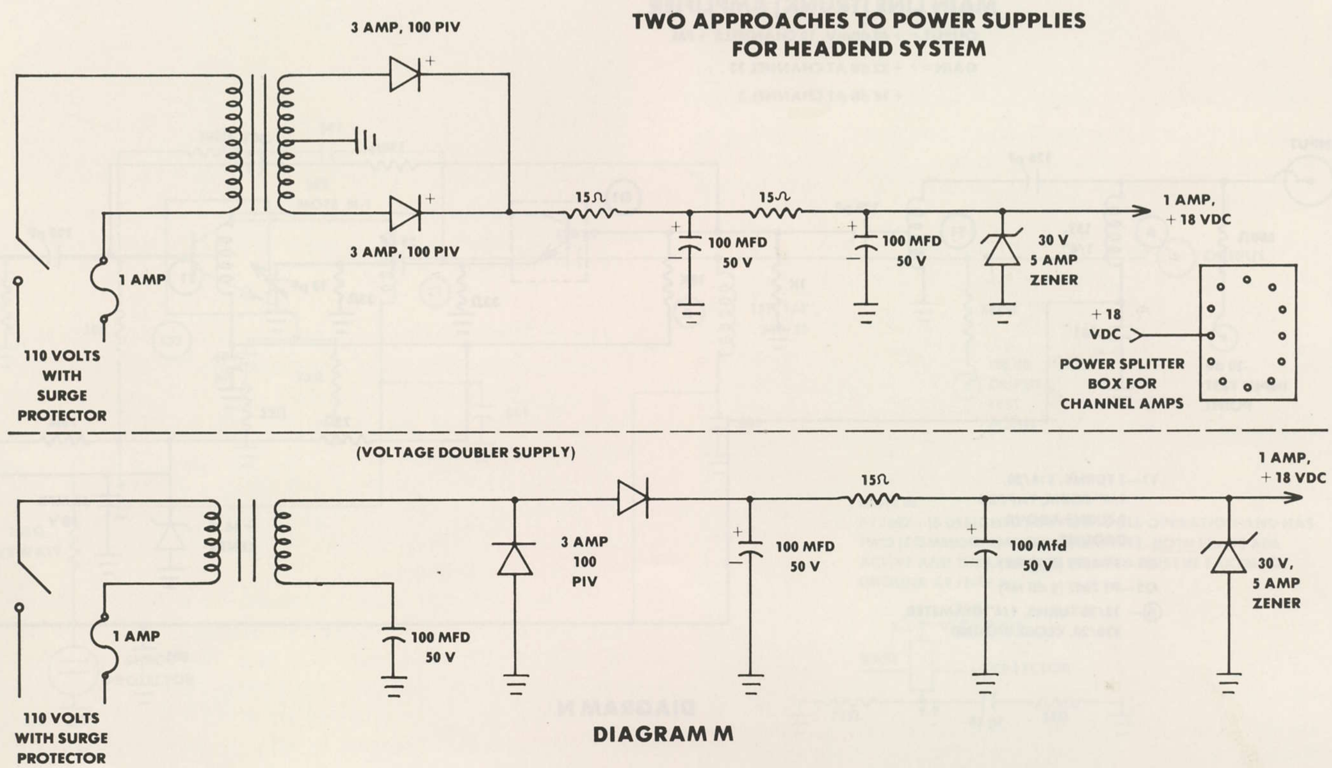
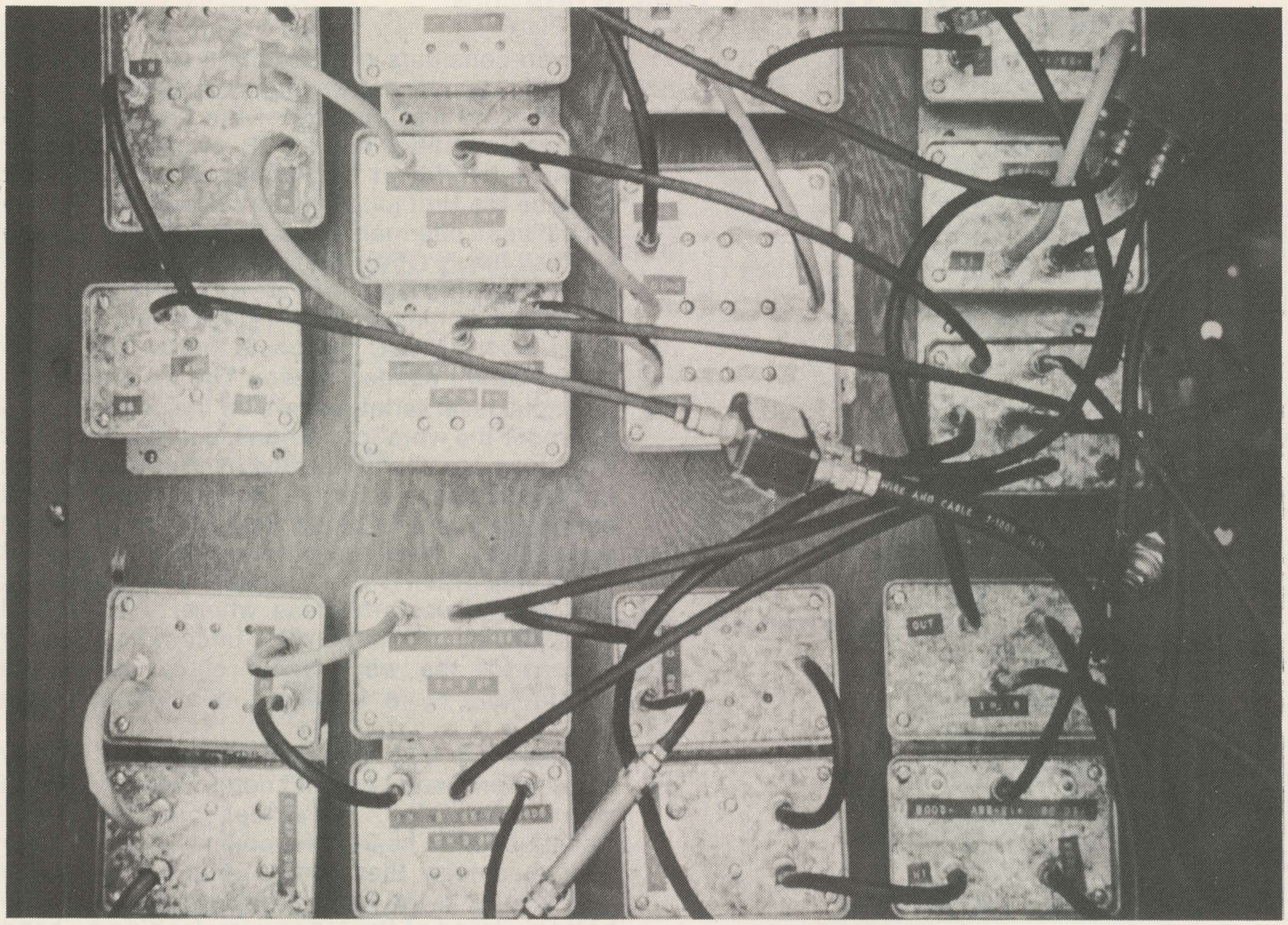


DIAGRAM M



A SWAN SMALL SYSTEM HEADEND uses plenty of "little boxes" salvaged from MATV sources for housings. Every channel is individually treated for gain and bandpassing/filtering. Main objection of course is lack of AGC action for system.

MAIN LINE [TRUNK] AMPLIFIER
OUPUT = + 40 dBmV, 10 CHANNELS + FM
GAIN = † + 22 dB AT CHANNEL 13
+ 10 dB AT CHANNEL 3

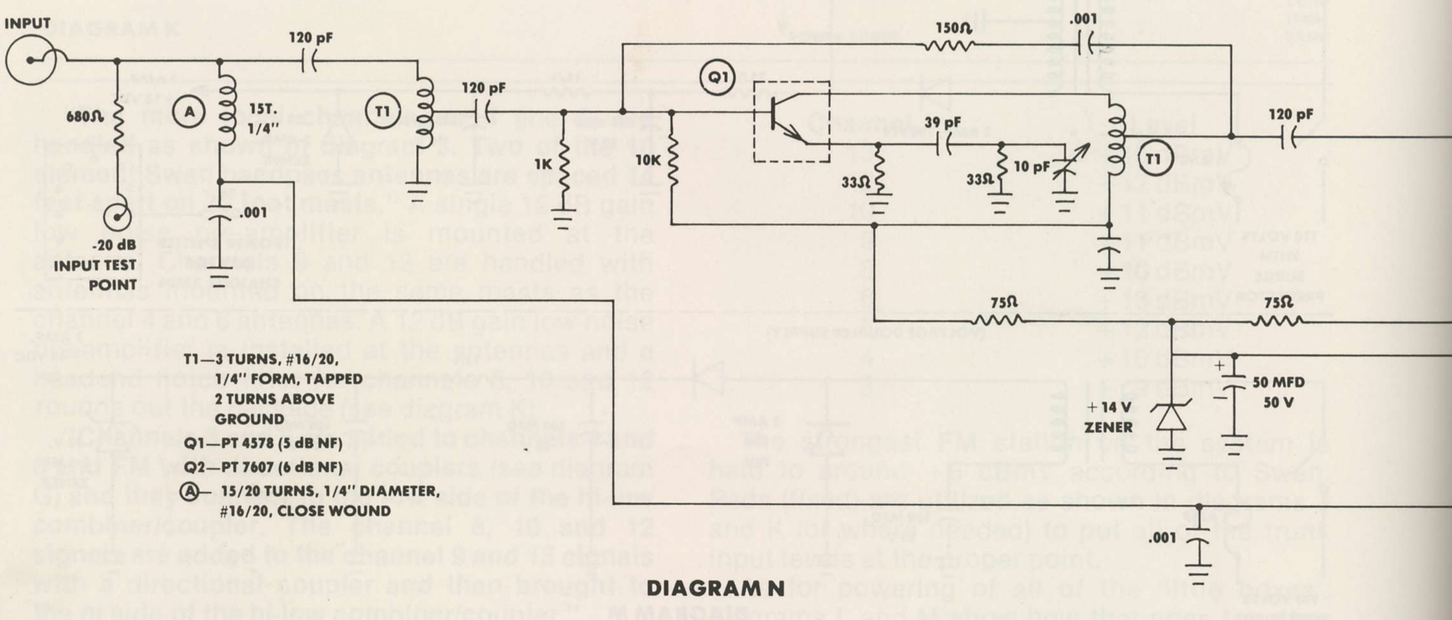
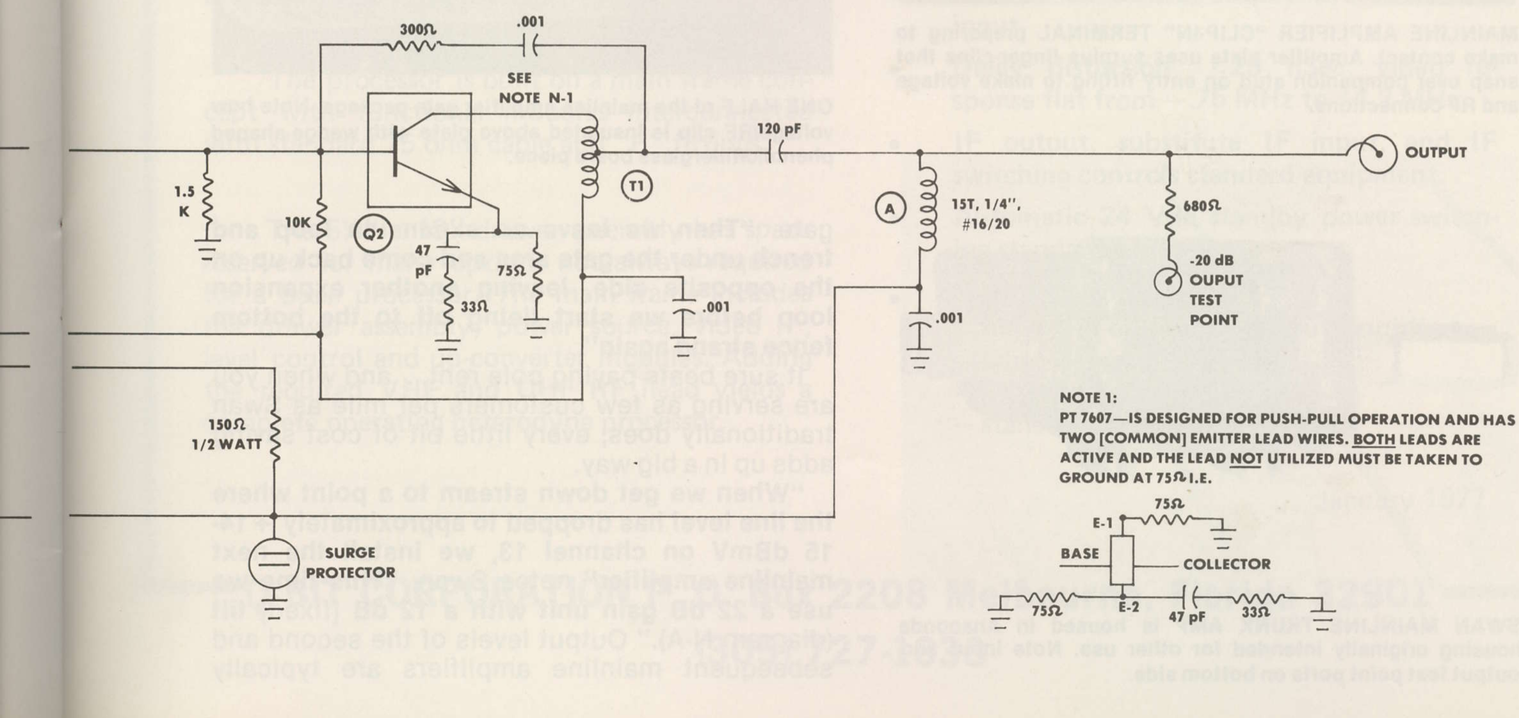


DIAGRAM N

SWAN MAINLINE AMPLIFIER uses point to point wiring techniques; DC powering (18 volts) comes into amplifier through cable line.



HIGHER GAIN MAINLINE [TRUNK] AMPLIFIER WITH ADJUSTABLE TILT (TAPER)

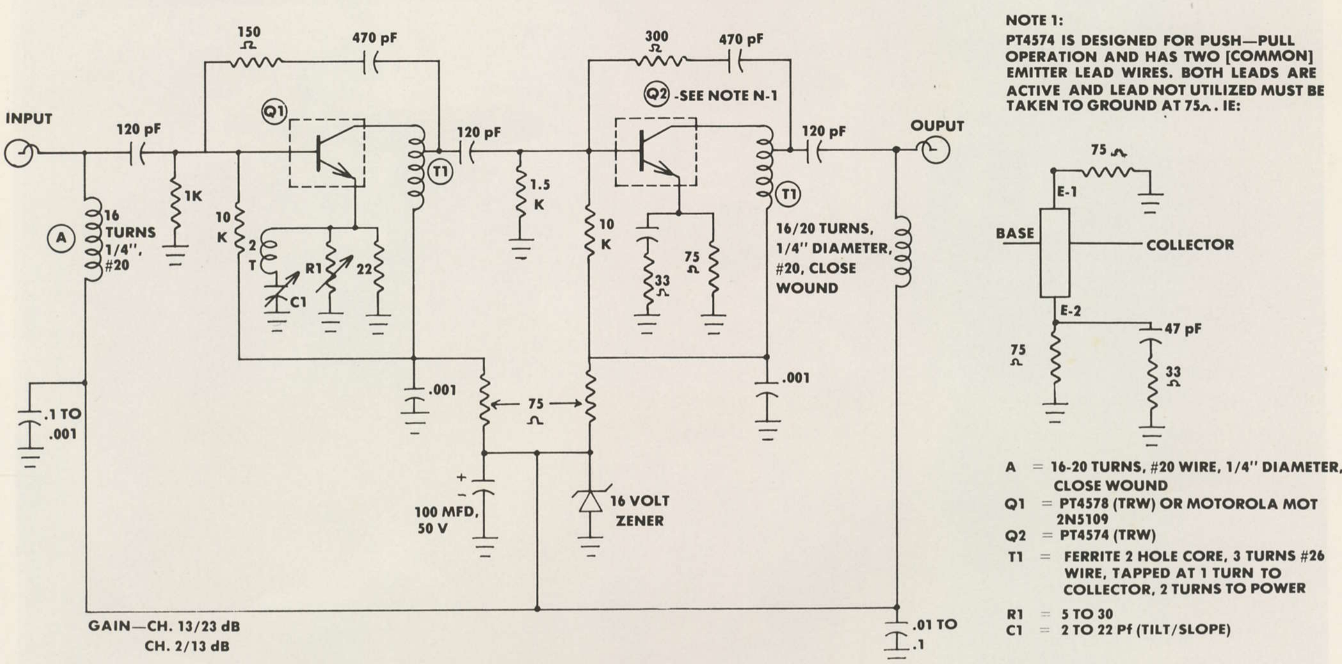
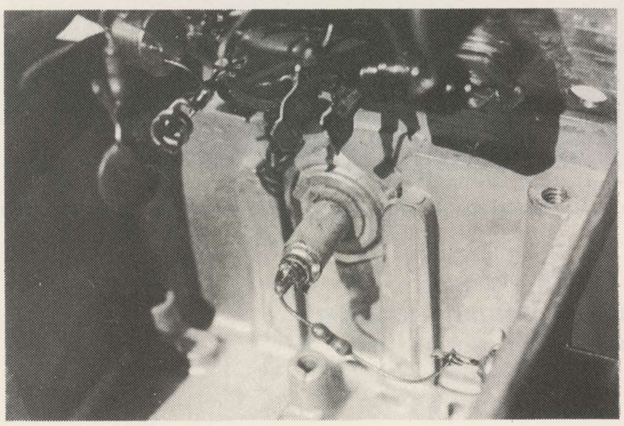
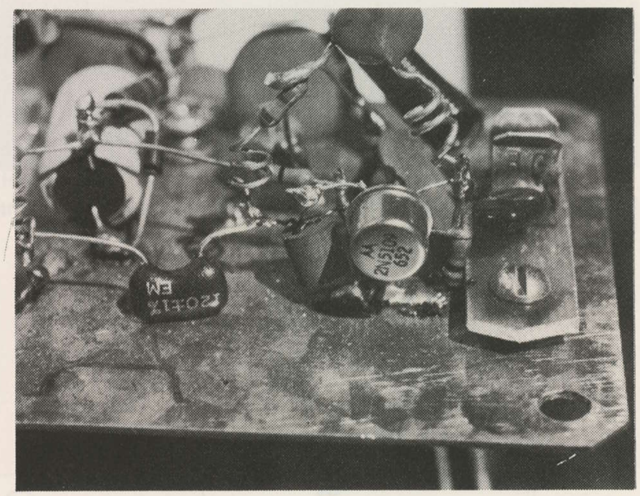


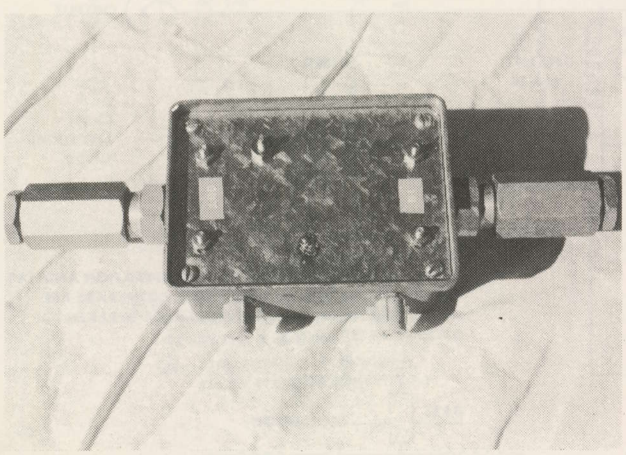
DIAGRAM N-A



MAINLINE AMPLIFIER "CLIP-IN" TERMINAL preparing to make contact. Amplifier plate uses surplus finger-clips that snap over companion stud on entry fitting to make voltage and RF connections.



ONE HALF of the mainline amplifier gain package. Note how voltage/RF clip is insulated above plate with wedge-shaped phenolic/fiberglass board piece.



SWAN MAINLINE TRUNK AMP is housed in Anaconda housing originally intended for other use. Note input and output test point ports on bottom side.

gate. **"Then we leave an expansion loop and trench under the gate area and come back up on the opposite side, leaving another expansion loop before we start tieing off to the bottom fence strand again".**

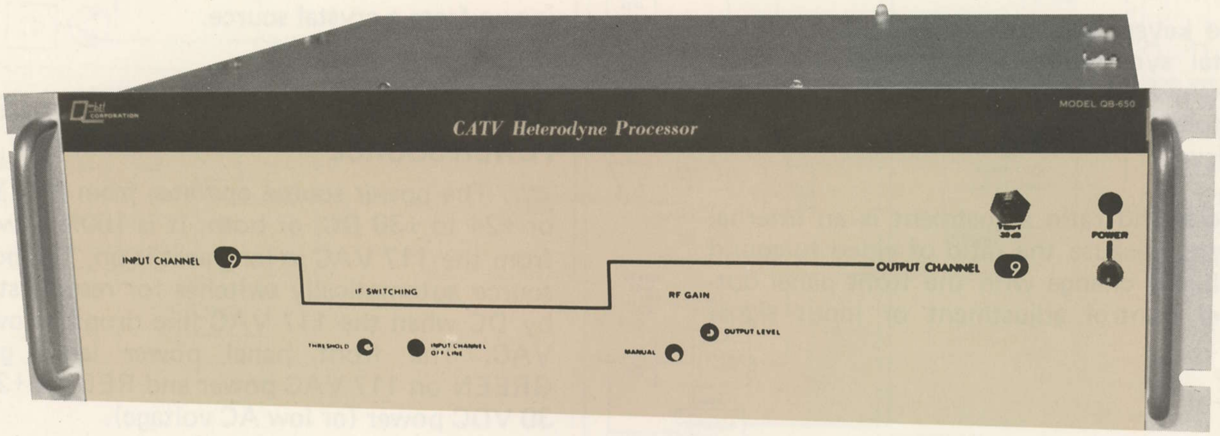
It sure beats paying pole rent. . .and when you are serving as few customers per mile as Swan traditionally does, every little bit of cost saving adds up in a big way.

"When we get down stream to a point where the line level has dropped to approximately +14-15 dBmV on channel 13, we install the next mainline amplifier" notes Swan. **"This time we use a 22 dB gain unit with a 12 dB** [fixed] **tilt** (diagram N-A)." Output levels of the second and sebsequent mainline amplifiers are typically

Q-BIT CORPORATION
MELBOURNE FLORIDA

HETERODYNE PROCESSOR

MODEL QB-650



The QB-650 Processor design utilizes the latest solid state technology and components. The stage filters are computer designed, optimizing bandpass flatness, group delay, and selectivity. Low spurious double balanced mixers are used for down and up conversions. Integrated circuits are utilized in the IF stages, keyed AGC system and voltage regulator.

The processor is built on a main frame concept with functional modules interconnected with standard 75 ohm cable and "F" fittings.

The 5¼" x 19" drawer assembly has space reserved for many options not always required for a basic processor. The main frame includes the drawer assembly, power source, video IF, level control and up-converter modules. Adding the required VHF and UHF RF head yields a complete operating heterodyne processor.

FEATURES

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

January 1977

Q-BIT CORPORATION P. O. Box 2208 Melbourne, Florida 32901
(305) 727-1838

AUTOMATIC GAIN CONTROL (AGC)

The level control module has two AGC systems. The video IF and front end gain are controlled by a keyed AGC system. The sound carrier is automatically controlled by a variable depth high Q notch filter. There is also a manual gain control for test purposes.

The keyed AGC circuit phase locks to the horizontal sync pulses and samples the peak level of the blanking pulse. This results in positive automatic gain control holding constant output level.

The sound ratio adjustment is an internal adjustment because the ratio of video to sound level will not change with the front panel output level control adjustment or input signal level.

IF SWITCHING

IF switching is controlled from the level control electronics and/or from an external input on the rear panel. The IF switch has two switched inputs, one for the "on line" signal and one a substitute input which normally is brought out to rear panel. Also a processed on line IF output is brought out the rear panel. A front panel lamp indicates when the input channel is switched "off line".

The substitute IF input requires a processed signal. This IF input/output arrangement allows many possibilities for use of these features. For instance, IF inputs and outputs can be cris-crossed between two processors allowing an automatic channel switch over in the event of loss of signal in one processor.

Internal switching control operates from loss of keyed TV sync or by a front panel threshold adjustment presetting to an AGC voltage. Either system can be defeated by controls.

RF HEADS

Both VHF and UHF heads have a standard 44 MHz output frequency. The VHF head incorporates a field effect transistor input, double balanced mixer and input filter. The input filter is 6 MHz wide and can be by-passed if a special purpose external filter is desired over the standard unit.

The UHF head incorporates a dual cavity, iris-coupled input filter 6 MHz wide. This is followed by a low-noise mixer/IF combination. The mixer is a balance type using Schottky diodes. The local oscillator is derived by multipling up from a crystal source.

POWER SOURCE

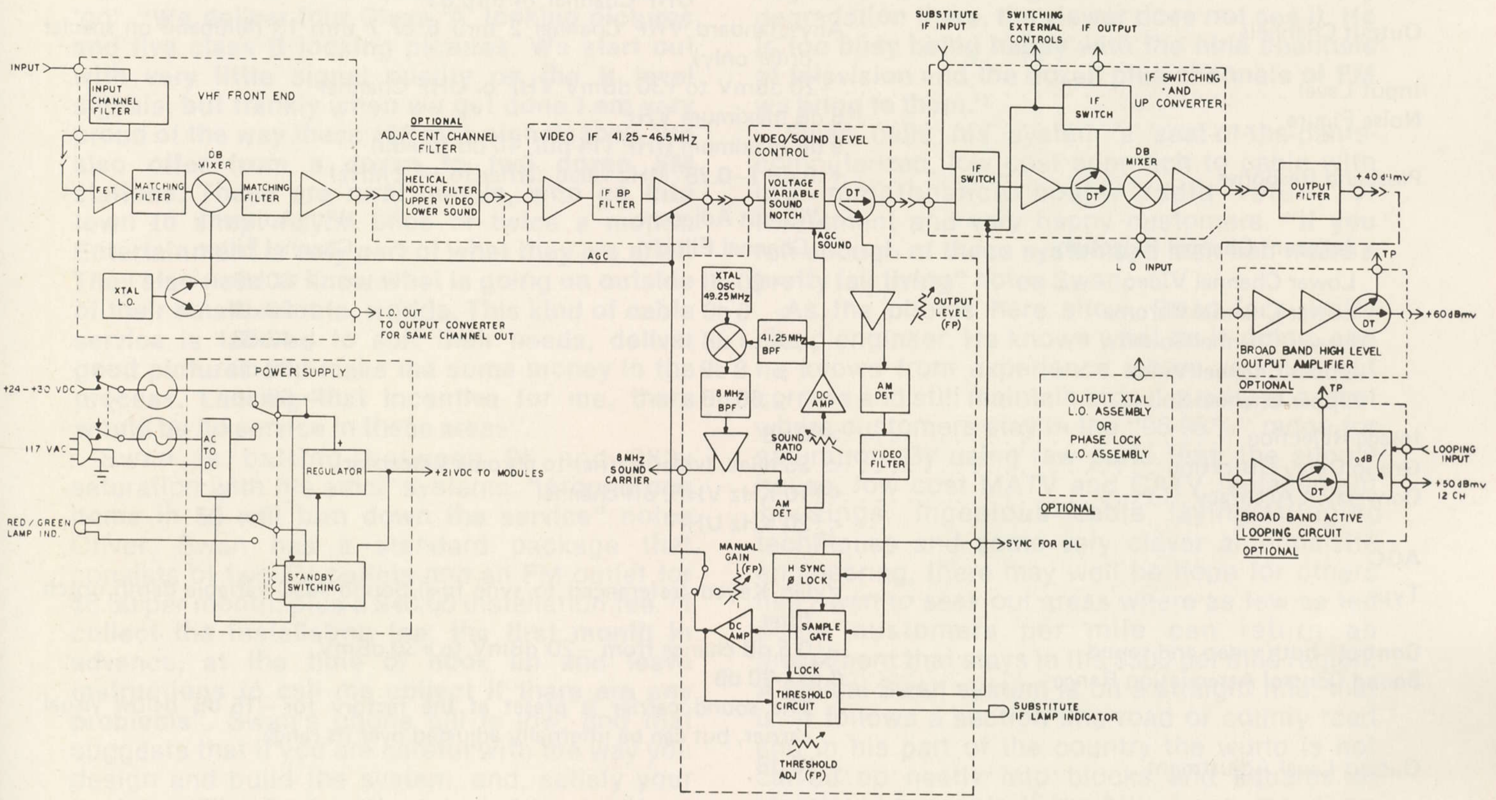
The power source operates from 117 VAC or +24 to +30 DC, or both. It is 100% powered from the 117 VAC as long as it is on. The power source automatically switches for reserve standby DC when the 117 VAC line drops below 85 VAC. The front panel power lamp glows GREEN on 117 VAC power and RED on +24 to 30 VDC power (or low AC voltage).

SERVICING AND TEST

Servicing and alignment procedures do not require any extenders or special fixtures. The top cover removes with snap fasteners for access to modules. The bottom cover can also be removed for alignment of R.F. circuits and filters. Functional circuit modules are interconnected with standard cable and F - fittings with 75 ohm interface. Thus test and fault isolation to a module circuit assembly is a relatively straight forward procedure. All circuit modules and P.C. cards can be removed or traded out without having to use a soldering iron.

A comprehensive service manual is also available defining module specification, circuit theory of operation, and test and alignment procedures. It includes scope photographs of proper filter responses and wave forms. Semiconductors and integrated circuits are standard commercially available components and the included parts list relates components back to the original manufacturer.

Q-bit also stocks all components, p.c. assemblies and modules for replacement or spares. Likewise, 24 hour turn around repair service or consultings are always available for Q-bit Corporation products.



OPTIONS

▲ The adjacent channel IF filter is offered as an extra option because it is not always required. The video IF module does an adequate channel filtering process with exceptions of the near in adjacent channel video and sound carriers. The adjacent channel elliptical filter has deep double notches at these frequencies. This requires very large and high Q helical resonators so the resultant response will be flat in the required IF passband. The adjacent channel filter has 75 ohm interfaces and simply plugs in series between the RF head and the video IF input.

▲ Different channel outputs require only an additional crystal controlled oscillator PC module to be added. This module is the same as used in the VHF RF heads and requires only a cable jumper to the output mixer LO input. Since the oscillator modules have two outputs, measuring the channel output frequency requires only a frequency counter. Just measure the input and output oscillator frequency and compute the output frequency offset.

▲ The processor up-converter output can be run at a +40 dBmV level. Processor outputs can be combined at these levels and run through one line amplifier such as a Q-bit Corporation DA-0550 amplifier and be on line with a 12 channel output up to +42 dBmV.

For the unit to be compatible with other manufacturer's processors, other output options are offered. 1) a 20 dB gain output amplifier with +60 dBmV output capability or 2) a broadband active looping amplifier having 0 dB looping loss and a +50 dBmV, 12 channel capability.

▲ The phase lock option allows one processor output frequency to be synchronized (locked) to the input frequency of another operating processor. This option is desirable when strong local TV signals may be leaking into a cable distribution system. Synchronizing another channel carrier at the same frequency can greatly diminish the leakage problems.

▲ An optional standby battery charger requires only two series automotive batteries for complete standby capabilities for any number of processors. The Model 651 charger does all the right things for standby battery service: 10 amp equalize charge for fast recharge, dropping to a float voltage required for standby service.

QB-650 PROCESSOR SPECIFICATIONS

Type	Super Heterodyne
IF	45.75 MHz Video Carrier and 41.25 MHz Sound Carrier
Input Channels	Any standard VHF Channel 2 thru 6 or 7 thru 13 UHF Channel 14 thru 83
Output Channels	Any standard VHF Channel 2 thru 6 or 7 thru 13 (Midband on special order only)
Input Level	–20 dBmV to +30 dBmV VHF or UHF Channel
Noise Figure	6 dB maximum VHF 9 dB maximum UHF (14-50), 10 dB (50-83)
Passband Response	± .5 dB (–0.75 MHz video carrier to +4.2 MHz)

Adjacent Channel Rejection	Without Adjacent Channel Filter	With Adjacent Channel Filter
Lower Channel Video	> 60 dB	> 60 dB
Lower Channel Chroma	> 6 dB	> 20 dB
Lower Channel Sound	> 1 dB	> 42 dB
Upper Channel Video	> 8 dB	> 50 dB
Upper Channel Sound	> 60 dB	> 60 dB

Image Rejection	>60 dB
Group Delay Distortion	< 25 nSec. (video carrier to chroma subcarrier)
Conversion Accuracy	<±10 KHz VHF; off channel <±20 KHz UHF

AGC

Type	Video Keyed (referenced to sync tips) Sound AGC variable depth notch filter
Control - both video and sound	<±0.5 dB change from –20 dBmV to +30 dBmV
Sound Control Attenuation Range	0 to –20 dB The sound carrier is preset at the factory for –15 dB below visual carrier, but can be internally adjusted over its range
Output Level Adjustment	> 10 dB

Output Options	Standard	High Level Amp	Looping Amplifier
RF Gain	> 60 dB	> 80 dB	> 75 dB
Maximum Output Level	+ 40 dBmV	+ 60 dBmV	+ 55 dBmV

Spurious Outputs	>60 dB down (referenced to video carrier)
Substitute IF Input Level	+25 dBmV for maximum processor output
Processed IF Output	+25 dBmV at maximum processor output
Switch Isolation	>50 dB
External Switching Control	
as input	Grounding (OV) causes processor to switch OFF channel to substitute IF input
as output	0 + 0.5V indicates processor switched OFF line +12V indicates normal operation
Internal Switching Delay	.5 seconds
Threshold Switching Control	Operates from AGC voltage
Presets From	<-20 dBmV to >+10 dBmV
Input/Output RF Impedance	75 ohm, RTL > 16 dB
Power	117 VAC, 60 Hz, 45 Watts +24 to +30 VDC, 0.6-1 Amp depending on options
Dimensions	19" rack mount by 5¼" high by 15" deep Provisions for slide mounting
Temperature	40^{o}F to $+140^{o}$F
Lightning and Transient Protection	Gas discharge RF input Varistor 117 VAC input Surge Zener +24 Volt input

WARRANTY

(a) Seller warrants that for a period of one (1) year after delivery, all equipment manufactured by the Seller shall be free from all deficiencies in design, material and workmanship. Seller further warrants that this equipment is tested prior to delivery to meet all operational specifications, including those applicable to Part 76.605 of the FCC Regulations as effective on the date of delivery.

(b) The obligations of the Seller under the warranty herein stated shall be strictly limited to repair or replacement of the defective work or materials in accordance with the warranty provision and in no event shall seller be liable for any special contingent or consequential damage or damages. The owner or user assumes full responsibility for maintaining operational performance after accepting delivery of the equipment. This warranty excludes liability for damages due to physical abuse or from subjection to service conditions beyond the specification limit or intended use of the equipment.

(c) There are no express warranties of merchantability or fitness or any other warranties expressed or implied which extend beyond the description of the warranties set forth herein.

+35 dBmV on channel 13 and +28 dBmV on channel 3.

Swan sets out to be practical from the word 'go'. **"We deliver four Class 'A' looking pictures and five class B looking pictures. We start out with very little signal quality on the B level signals, but frankly when we get done I am very proud of the way these 190 mile signals look. We also offer from a dozen to two dozen FM stations. These are rural people, who go into town to shop maybe once or twice a month. Entertainment is only part of what they are after. They also need to know what is going on outside of their small, remote, worlds. This kind of cable service is tailored to suit their needs, deliver good pictures and make me some money in the process. Lacking that incentive for me, there would be no service in these areas".**

Swan is batting between 95 and 98% saturation with his small systems. **"Around one home in 50 will turn down the service"** notes Oliver. Swan has a standard package that consists of two TV outlets and an FM outlet for $6.50 per month; plus a $40.00 installation fee. **"I collect the installation fee, the first month in advance, at the time of hook up and leave instructions to call me collect if there are any problems".** Swan's phone bill is low, and that suggests that if you are careful with the way you design and build the system, and, satisfy your customers, you can afford to be so generous with collect long distance calls.

Swan taps off signal using the directional tap approach; in other words, his mainline is his tapped line, but he uses directional couplers for service. Swan will typically bury RG-6 from the coupler into the home "starting at the fence". Where there is a need to equalize the tilt (as the system cascades) Swan uses a device similar to that shown in diagram 0 (an 8 dB fixed tilt unit).

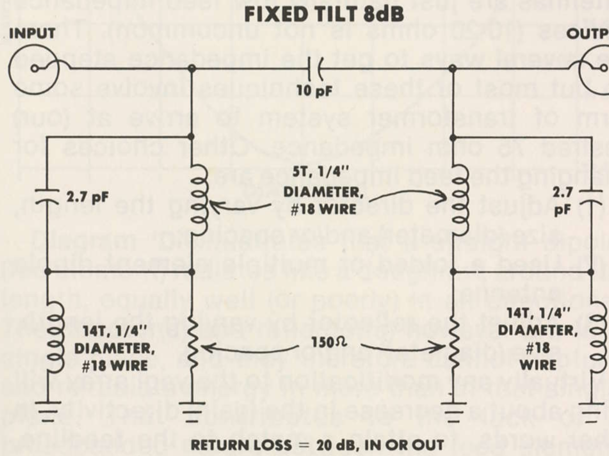


DIAGRAM 0

"In a typical system, after four or five miles of 'plant', only a trained eye could detect the slightest hint of degradation. If there is any degradation there, the viewer does not see it. He is too busy being happy with the nine channels of television and the dozen plus channels of FM we bring to them."

Swan calls his system a seat-of-the-pants-computerized, low cost approach to cable with low maintenance costs, rapid return of investment and very happy customers. **"If you run enough of these systems, a man can make a pretty fair living"** notes Swan.

As the photos here show, Swan is a pretty sharp engineer. He knows what he is doing, and he knows from experience where you can cut corners and still maintain signal quality at a level where customers stay in the "95-98%" range for saturation. By using raw parts from the supply house, low cost MATV and CATV replacement housings, ingenious cable laying/stringing techniques and some very clever antenna-site engineering, there may well be hope for others like Swan to seek out areas where as few as ten cable customers per mile can return an investment that stays in the $500 per mile region. A typical Swan system is on a straight line; that is, it follows a section line road or county road and in his part of the country the world is not carved up neatly into blocks and squares of streets with people living hither and yon. Even within a five mile cable-shot in **two** directions, at 10 homes average per mile, you are looking at 100 homes of $650.00 per month gross income for a plant that extends in only two directions from a headend site. If by chance you could go in four directions from a single site, you are looking at $1300 gross income per month, with four 5-mile runs.

Oliver Swan obviously enjoys a good life which many others would like to emulate. Being one's own boss, having a "cable-trap-line" to run every week and the free time to build your own equipment is not exactly a bad form of life. Oliver Swan has done it, and hundreds of Arizona and New Mexico families are better off because Oliver Swan 'retired' there.

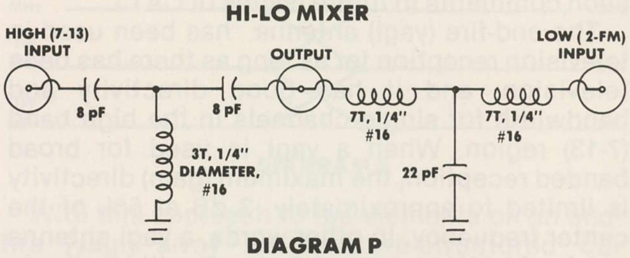


DIAGRAM P

World's Longest Logi?

A NEW HIGH BAND ANTENNA THAT GIVES RHOMBICS A GOOD RUN FOR THEIR MONEY

End Fire/Broadside/Surface Wave???

Most cable people have a natural interest in antennas; it is, after all, the antenna which separates the cable receiving site from the home receiving site. As the previous report pointed out, when you are serving rural cable subscribers with as few as ten homes per mile you have to be extremely clever with your off-air receiving site to make the whole system financially feasible. And as pointed out previously, Arizona's Oliver Swan is clever.

The data supplied to CATJ by Oliver Swan is his own data. It does not all find verification in antenna reference manuals. We point this out because we anticipate receiving a number of letters from "antenna engineers" in the crowd who find one or more reasons to dispute some of Oliver Swan's statements, numbers or diagrams. Our position in this is very simple. Oliver Swan's antennas work. They have worked for more than 25 years now. Admittedly they have never previously received national (or world wide in our case) attention. That is no fault of Oliver Swan nor does it in any way tarnish the ability of his antennas to produce signals in areas where previously no signals existed at a useable level. Swan's antennas are in regular use in some very remote areas, providing television reception over paths as long as 385 miles. We know. . .we've been there and we've seen them work.

So we anticipate hearing from people who find some of Oliver's statements difficult to equate to their own experiences. We'll gladly print any such comments in future issues of CATJ.

The end-fire (yagi) antenna has been used in television reception for as long as there has been television, and it has good directivity and bandwidth for single channels in the high band (7-13) region. When a yagi is used for broad banded reception, the maximum (gain) directivity is limited to approximately -3 dB at 5% of the center frequency. In other words, a yagi antenna cut for 61 MHz (channel 3 visual) will have gain plus or minus 3 dB of the maximum gain at a frequency 5% below 61 MHz (57.95 MHz) and at a frequency 5% above 61 MHz (64.05 MHz). Keep in mind that this "3 dB point" means gain has fallen off by 3 dB by this point(s) in the spectrum. **See diagram 'A' here.**

YAGI GAIN VS. OPERATING FREQUENCY

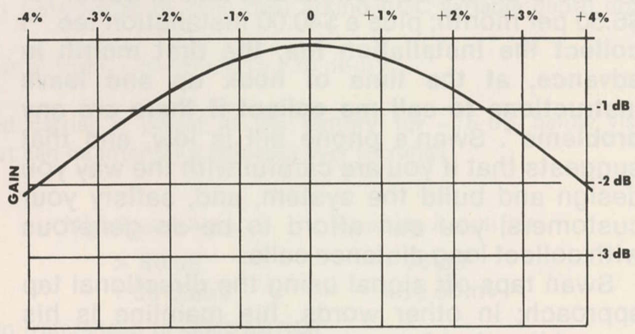


DIAGRAM A

Thus the yagi will not work very well at low band frequencies, although it is useable within the 3 dB criteria for high band frequencies (5% below 181 MHz [channel 8] is 171.95 MHz while 5% above 181 MHz is 190.05 MHz; well within the 180-186 MHz spread of channel 8).

The yagi has another inherent problem and that is impedance. Multiple element yagi antennas are just naturally low feed impedance devices (10-20 ohms is not uncommon). There are several ways to get the impedance stepped up but most of these techniques involve some form of transformer system to arrive at (our) desired 75 ohm impedance. Other choices for changing the feed impedance are:

(1) Adjust the director by varying the length, size (diameter) and/or spacing;

(2) Used a folded or multiple element dipole antenna;

(3) Adjust the reflector by varying the length, size (diameter) and/or spacing.

Virtually any modification to the yagi array will bring about a decrease in the (gain) directivity. In other words, to attain a match to the feedline, some of the desirable directivity (gain) must be sacrificed.

What is it about the yagi which makes it a frequency-selective antenna? The directors, it turns out, are relatively broadband in nature **(see**

diagram 'B'). The driven element is a relatively "hi-Q" circuit however, and unless modified, it wants to work on one frequency best. When there is a mismatch between the "fed element" and the feedline, the mis-match in impedance between the two creates loss **(see diagram 'C').** It might be worthwhile to ask at this point why the feed system is inadequate.

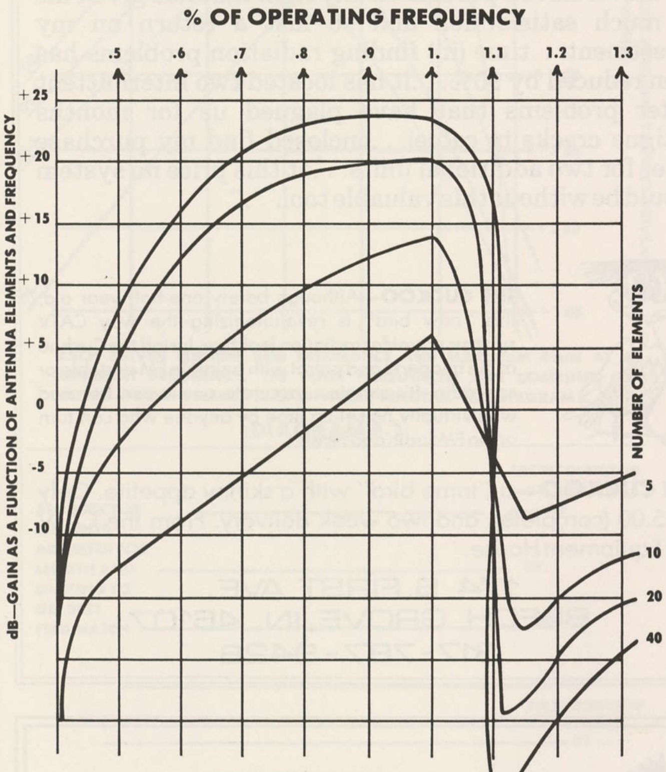


DIAGRAM B

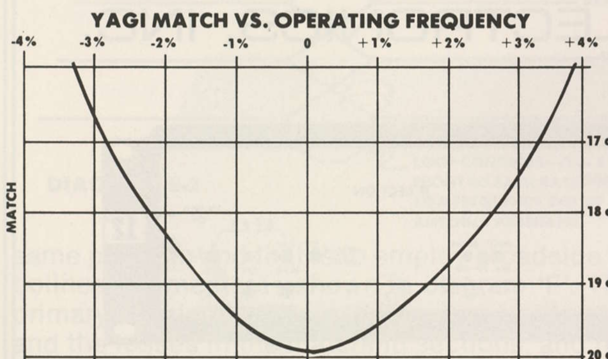


DIAGRAM C

Diagram 'D' illustrates that a straight dipole (fed element) radiates like a doughnut, around its length, equally well (or poorly) in all directions. The director(s) and reflector(s) however are in a single plane, and they therefore cannot capture and re-radiate energy in more than in that single plane. That contributes to the lack of a broadbanded nature between the feed element (dipole) and the balance of the antenna array. The fed element in effect becomes a form of parasitic "bandpass filter" hanging in space and "tuned" by the elements around it to a "hi-Q" condition. It might be useful, if you are into bandpass filters, to picture the yagi or end fire array as an "interdigital bandpass filter" suspended in space.

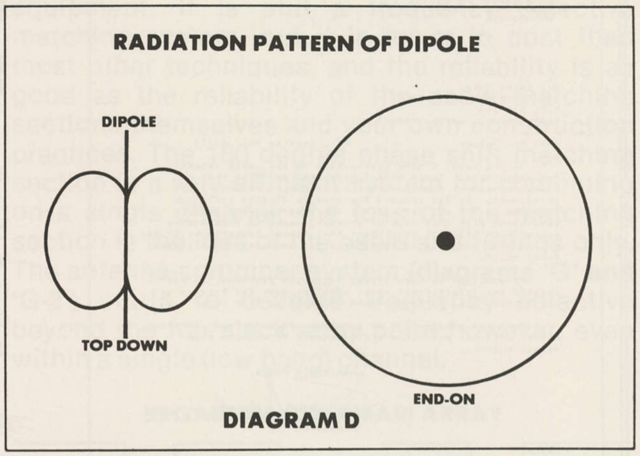


DIAGRAM D

One way around this problem is to modify the feed system of the yagi or end fire array **(see diagrams 'E', 'E-1' and 'E-2')** four separate ways, as follows:

(1) Modify the distance to the directors (director loading affects fed element resistance or impedance);

(2) Modify the feed resistance (impedance) of the fed portion of the antenna, by combining in series-parallel separate fed elements;

(3) Modify the directivity of the feed system (by combining fed or active elements some of the circular properties of a single fed element are warped into a more linear format);

(4) Modify the bandwidth of the fed-element segment by broad banding the feed system with series-parallel connected sections operating on slightly different frequencies **(diagram 'E-1').**

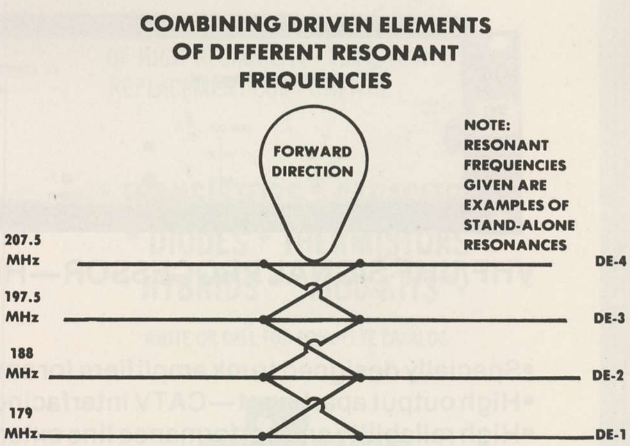
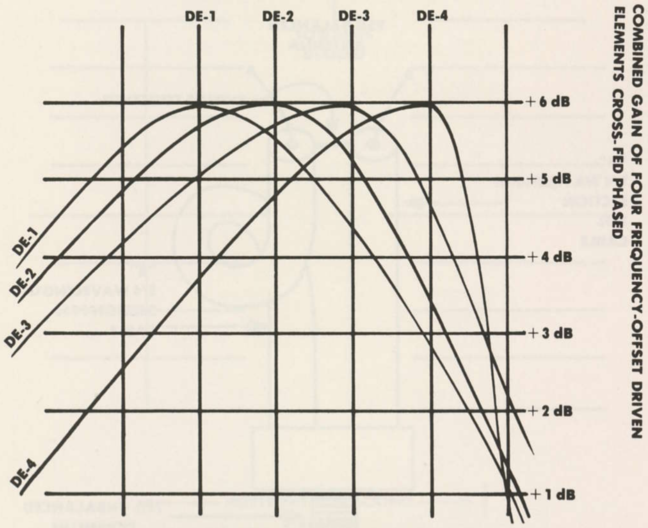


DIAGRAM E

With this approach to fed elements on an end-fire (yagi) array we have re-structured our bandwidth of the antenna with optimum (gain) directivity plus we have arrived at a 75 ohm (balanced) feed system without transformers.

In fairness, there is another solution to the

EFFECTIVE GAIN [OVER SINGLE DIPOLE] OF FOUR DRIVEN ELEMENTS



EACH DRIVEN ELEMENT SEES RESONANCE AND MAXIMUM GAIN AT A DIFFERENT FREQUENCY. THE FOUR FREQUENCIES ARE COMBINED BY CROSS—FEEDING ELEMENTS OF DIFFERENT LENGTHS. SEE DIAGRAM E.

DIAGRAM E-1

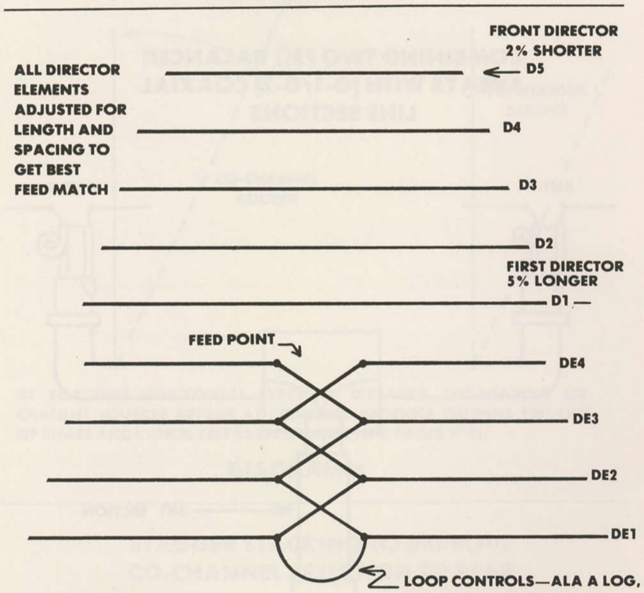
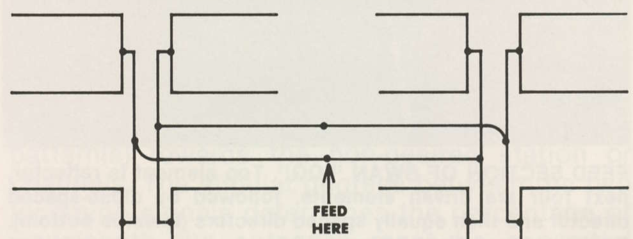


DIAGRAM E-2

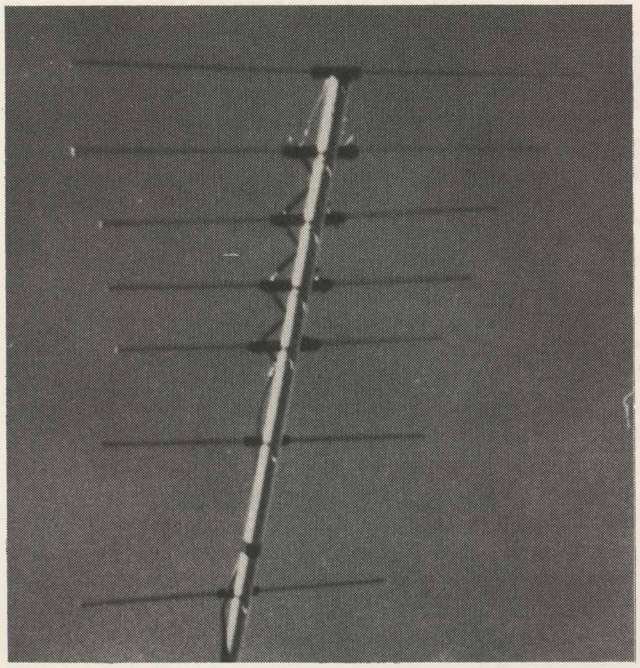
same problem and that is to employ broadside or colinear elements as shown in **diagram 'F'.** The primary problem with a colinear array is its size and the losses in the matching sections; and the matching sections will be frequency selective. But the broadside or colinear type of array is informative none the less because it illustrates how multiple yagi or end fire arrays, constructed so as to form a multiple antenna array, can be combined so that the gain of the entire array is the gain of the sum of the various component antennas. One approach to combining antennas, not often practiced in CATV headends, is to throw away the combiners typically utilized to combine arrays and to substitute matching sections of coaxial cable **(diagrams 'G' and 'G-1').** It works out **(diagram 'G')** that if you utilize commonly available 50 and 75 ohm cable, as shown in **diagrams 'G'** and **'G-1'** to create matching sections and balanced to unbalanced transformers, you can eliminate any external ferrite or other matching and combining equipment. It is still a frequency selective matching system, but it is lower in cost than most other techniques, and the reliability is as good as the reliability of the cable matching sections themselves and your own construction practices. The 180 degree phase shift matching section is a very efficient system for combining on a single channel; the loss of the matching section is the loss of the cable and fittings only. The antenna-combiner system **(diagrams 'G' and 'G-2')** starts to become frequency selective beyond the fourstack array point however, even within a single (low band) channel.

BROADSIDE (COLINEAR) ARRAY



THIS TYPE OF ARRAY (DIPOLES ONLY SHOWN) HAS A BROADER FREQUENCY RESPONSE BUT MATCHING SECIONS ARE FREQUENCY SELECTIVE

DIAGRAM F



FEED SECTION OF SWAN 'LOGI'. Top element is reflector, next four are driven elements, followed by close-spaced director and then equally spaced directors (towards bottom). Downline tapes along boom.

75Ω BALANCED TO 75Ω UNBALANCED SECTION

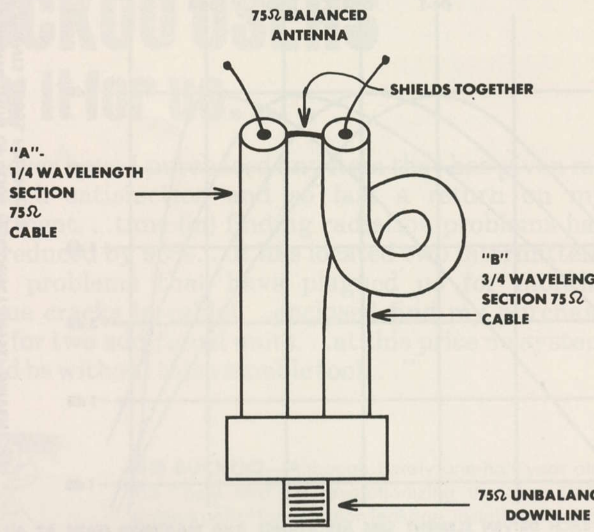


DIAGRAM G-1

COAXIAL LINE SECTION ANTENNA COMBINING

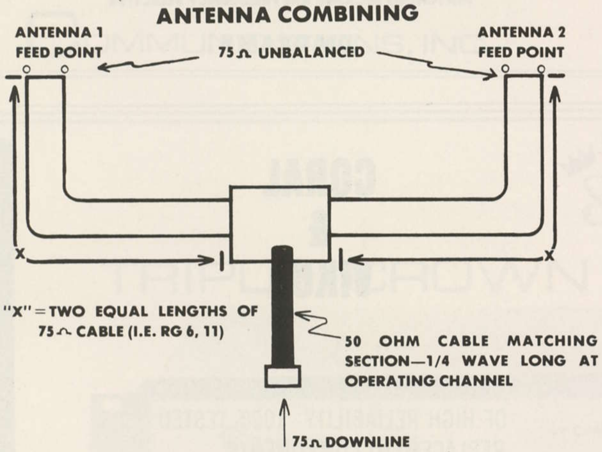


DIAGRAM G

COMBINING TWO 75Ω BALANCED ARRAYS WITH [G-1/G-2] COAXIAL LINE SECTIONS

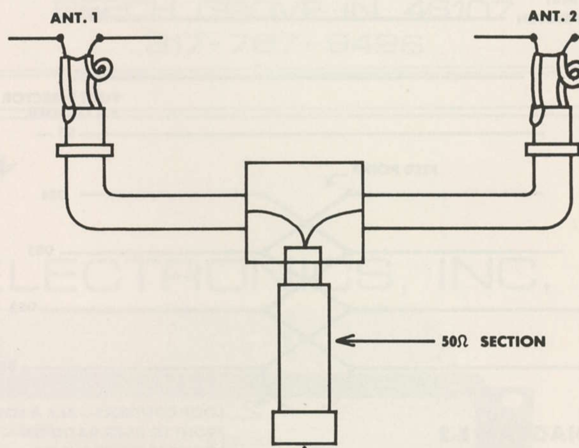
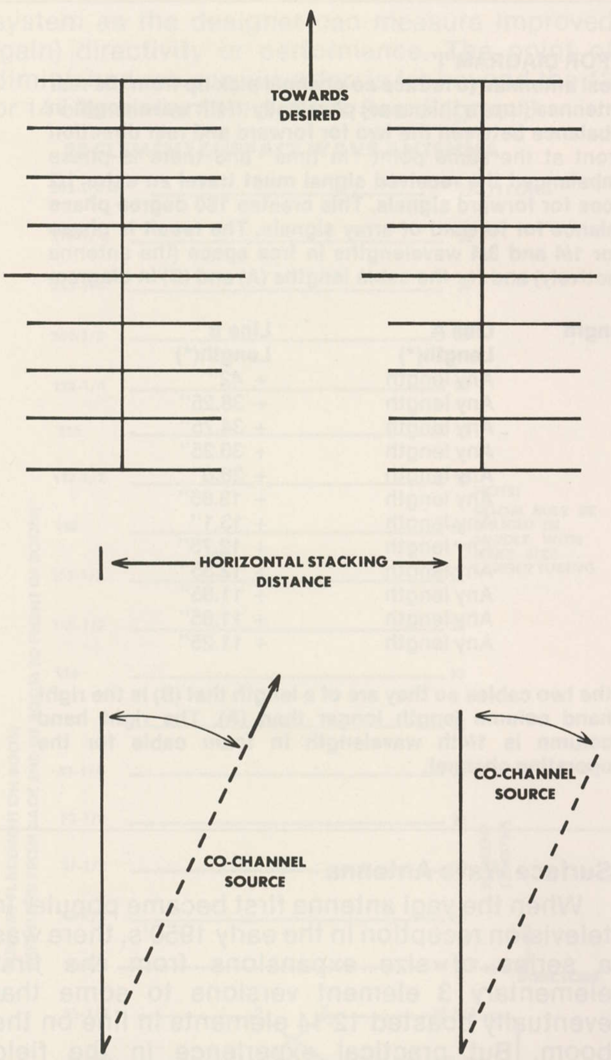


DIAGRAM G-2

USEFUL DIMENSIONS FOR DIAGRAMS 'G' AND 'G-1'

The following cable-dimensions will be useful in constructing 1/4 and 3/4 wavelength sections of cable per diagrams 'G' and 'G-1'.

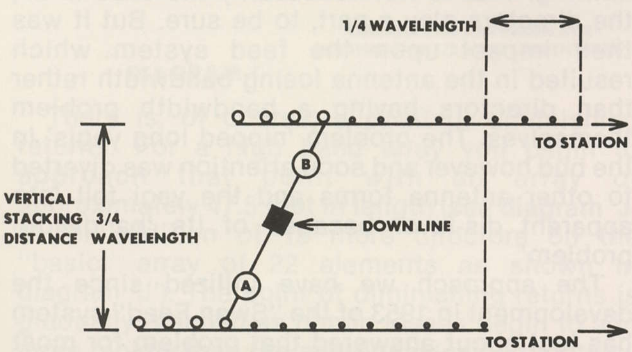
Channel	Frequency	1/4 wave in 75 ohm RG-6	3/4 wave in 75 ohm RG-6	1/4 wave in 50 ohm RG-8 (foam)
2	54- 60 MHz	42 "	125.75"	37.2"
3	60- 66 MHz	37.9"	113.9 "	33.6"
4	66- 72 MHz	34.7"	104.0 "	31.2"
5	76- 82 MHz	30.1"	90.4 "	26.9"
6	82- 88 MHz	28.1"	84.5 "	25.0"
FM	88-108 MHz			21.0"
7	174-180 MHz	13.5"	40.5 "	12.0"
8	180-186 MHz	13.1"	39.3 "	11.5"
9	186-192 MHz	12.7"	38.1 "	11.0"
10	192-198 MHz	12.3"	36.9 "	10.5"
11	198-204 MHz	12.2"	36.7 "	10.0"
12	204-210 MHz	11.9"	35.7 "	9.5"
13	210-216 MHz	11.2"	33.6 "	9.0"



BY SELECTING HORIZONTAL STACKING DISTANCE, OFF-HEADING CO-CHANNEL SOURCES APPEAR AT COMBINED ANTENNA OUTPUTS 180° OUT OF PHASE AND CANCEL (SEE CATJ FOR JUNE 1974; PAGES 7-16).

DIAGRAM H

STAGGER STACKING TO IMPROVE CO-CHANNEL REJECTION TO REAR



VERTICAL STACKING OF 3/4 WAVELENGTH IS PRACTICAL MINIMUM FOR EFFECTIVE GAIN [CAN BE INCREASED TO 1 WAVELENGTH FOR ADDITIONAL GAIN OF 1/2 dB]. ONE ANTENNA LEADS OTHER BY 1/4 WAVELENGTH IN FREE SPACE. SEE TABLE I-1 FOR LENGTHS OF COMBINING CABLES A AND B . .

DIAGRAM I

Some Figures

If your incoming wave front is uniformly distributed (i.e. it is arriving at the front of a multiple-antenna array at the same level and phase over the full array) the gain to be achieved with two stacks of antennas utilizing the coaxial combining and matching techniques outlined here is on the order of 2.8 dB over a single stack array. A four stack array will net approximately 5.5 dB gain over a single array, under the same incoming wave front conditions. When there are uneven wave fronts arriving at the multiple-antenna array, the net gain of additional stacks will often be much greater than the numbers given if you were to dis-connect an antenna that happened to be up high on signal level at that instant, and then compared it to an antenna that was by chance low in level at that point. This is the stuff that diversity antenna arrays are made of.

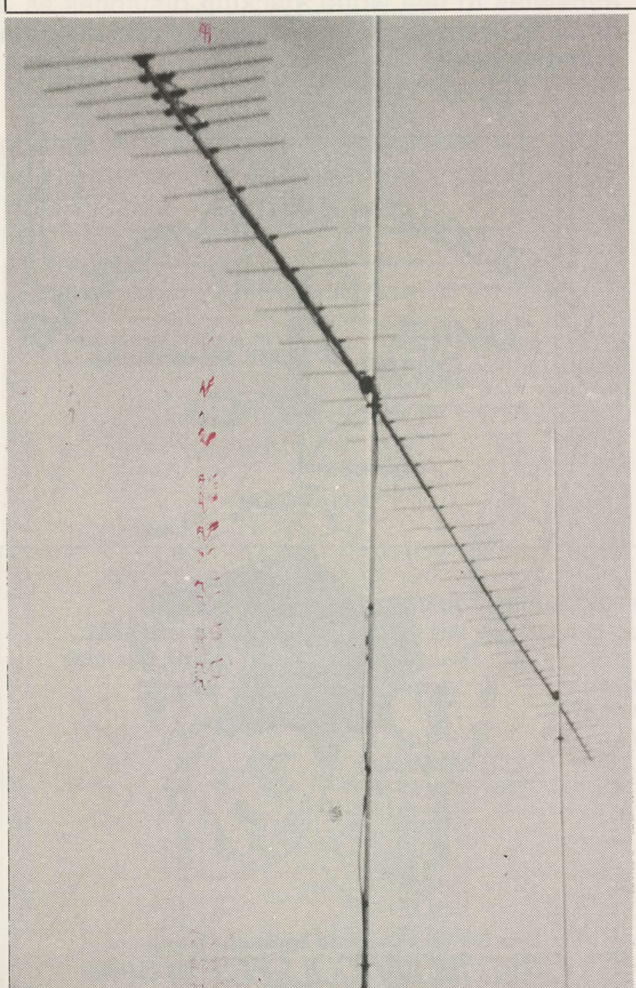
The two stack and the four stack array has more useful functions than gain alone of course. If you happen to have a co-channel or adjacent channel signal source problem, careful selection of the horizontal stacking distance **(see diagram 'H' and CATJ for June 1974, page 7)** can create very effective 20-40 dB "nulls" in the array pattern(s) towards the non-desired station or channels. The angular degrees between the two incoming signals determines the percentage of wavelength the antennas must be separated (again, see CATJ for June 1974, page 7) and this translates to real world stacking distances as a function of the operating frequency **(see diagram 'I' and table 'I')**.

USEFUL DIMENSIONS FOR DIAGRAM 'I'

Diagram 'I' shows one method of "stagger-stacking" identical antennas to reduce co-channel pick-up from the rear of the antenna system. By placing one of the two identical antennas (top in this case) **physically 1/4th wavelength in front of the second antenna you create a 90 degree phase imbalance between the two for forward and rear direction signals** (i.e. the two antennas do not intercept the wavefront at the same point "in time" and there is phase imbalance). **By making the stacking/phasing lines further imbalanced the received signal must travel an extra 1/2 wavelength to the combining point for rear signals than it does for forward signals. This creates 180 degree phase imbalance for rear-of-array signals, but 0 degree phase imbalance for forward of array signals. The result is phase cancellation of rear-of-array signals. Dimensions here are for 1/4 and 3/4 wavelengths in free space** (the antenna leading dimension and the vertical stacking dimension respectively) **and for the cable lengths (A) and (B) in diagram 'I'.**

Channel	3/4 Wavelength in space	1/4 Wavelength in space	Line A Length(*)	Line B Length(*)
2	153"	51"	Any length	+ 42"
3	139.5"	46.5"	Any length	+ 38.25"
4	127.5"	42.5"	Any length	+ 34.75"
5	111"	37.0"	Any length	+ 30.25"
6	103"	34.5"	Any length	+ 28.0"
7	49.85"	16.65"	Any length	+ 13.65"
8	48.75"	16.1"	Any length	+ 13.1"
9	46.5"	15.5"	Any length	+ 12.75"
10	45.35"	15.1"	Any length	+ 12.35"
11	43.85"	14.65"	Any length	+ 11.85"
12	42.5"	14.25"	Any length	+ 11.65"
13	41.65"	13.85"	Any length	+ 11.25"

*** - Coaxial combining lengths are for foam type combining cables. Both (A) and (B) cables are of such a length that the (B) cable is 1/4th wavelength (in cable) longer than the companion (A) cable. In other words, cut the two cables so they are of a length that (B) is the right hand column length longer than (A). The right hand column is 1/4th wavelength in foam cable for the operating channel.**



SWAN LONG-LONG 'LOGI' supports on twin poles (see diagrams L and M at end of report).

Surface Wave Antenna

When the yagi antenna first became popular in television reception in the early 1950's, there was a series of size expansions from the first elementary 3 element versions to some that eventually boasted 12-14 elements in line on the boom. But practical experience in the field showed that as the number of elements was increased, around a singular or even dual dipole feed system, the bandwidth of the antenna became worse and worse. Most people believed this band width limitation was the direct function of the directors being bandwidth limiting. That is not necessarily the case at all; the directors play a part, to be sure. But it was their impact upon the feed system which resulted in the antenna losing bandwidth rather than directors having a bandwidth problem themselves. The problem 'nipped long yagis' in the bud however and soon attention was diverted to other antenna forms and the yagi fell into apparent dis-favor because of its 'bandwidth problem'.

The approach we have utilized since the development in 1953 of the "Swan Feed" system has just about answered that problem for most conventional CATV uses of yagi antennas. The solution, we offer, is to modify the feed system as shown in diagram 'E' so that it "thinks" it is a broad banded feed system. Then the directors can be placed in front of the feed system without concern for what happens to the bandwidth; **for at least +/-12.5% of the operating frequency.** This results in an antenna system that can have directors added for as long in front of the feed system as the designer can measure improved (gain) directivity or performance. The point of diminished returns, we offer, is far beyond the 12 or 14 element antenna point. **See diagram J.**

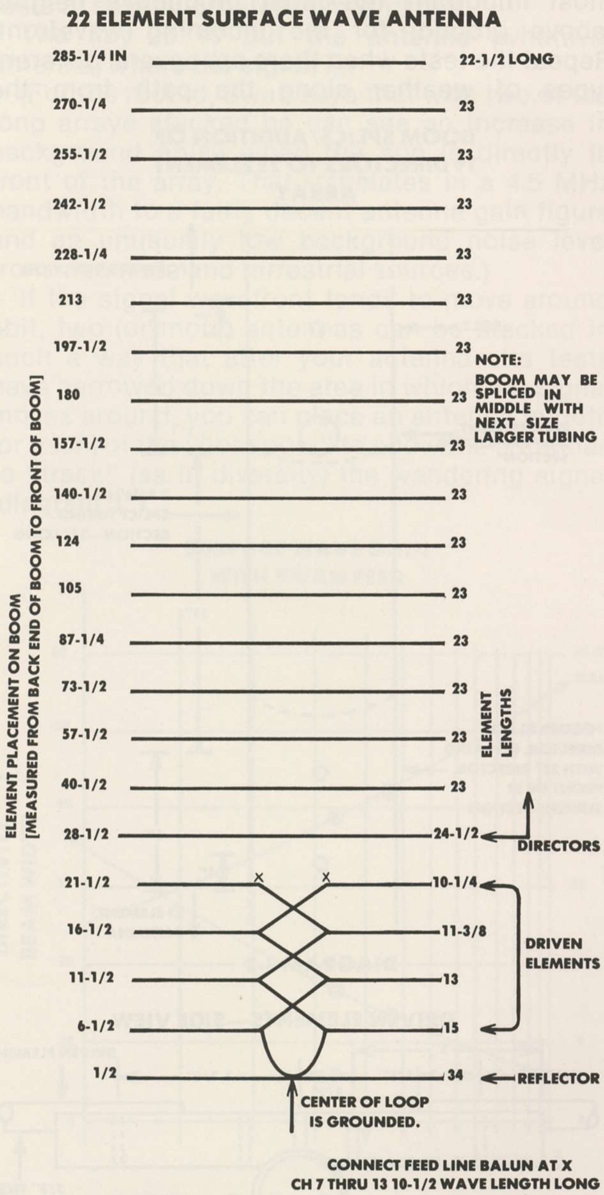


DIAGRAM J

There is, of course, a point of diminishing returns. For a high band array you begin to **approach** that point with an array of approximately 47.5 feet in length (**see diagram 'J-1'** for addition of 19 more directors on the "basic" array of 22 elements as shown in diagram 'J'). The point of diminishing returns is gradually reached as ohmic losses begin to add more rapidly than the additional (gain) directivity is added.

(**NOTE: The dimensions given in diagrams 'J' and 'J-1' are suitable for the self-construction of an identical array to that shown here. Diagram 'J-2' shows how the boom material is spliced to add the front 19 directors to the rear 22 elements. Diagram 'J-3' illustrates how the driven elements are insulated from the boom** [top] **and "cross fed"** [bottom]).

In case it has escaped you to this point, the only way an antenna "builds gain" is through increasing the directivity of the full array. And directivity comes by eliminating or reducing side and rear lobe responses and forcing the antenna to "see" only signals that are coming from wave fronts that enter the array from the forward direction (or over and along the directors which act as "guides" for the incoming wavefront). As the length of the array increases (i.e. directors are added) we have two things happening:

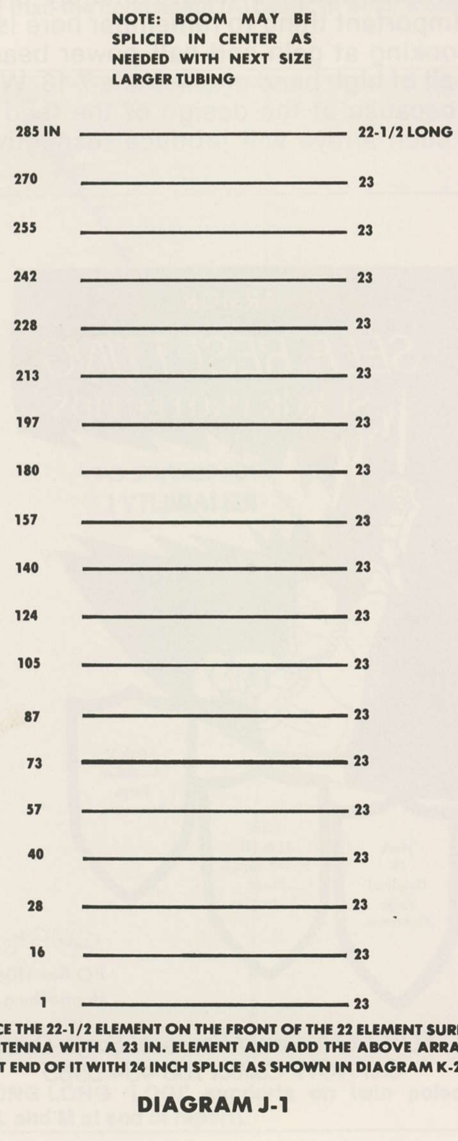
(1) The directivity or sharpness of the forward pattern improves (by becoming more and more narrow);
(2) And the gain of the array, correspondingly, increases.

This is shown in diagram 'K'.

In diagram 'K' we see that an antenna that is 8.5 half-wavelengths long (or the same as our basic 22 element array shown in diagram 'J') has a forward gain of 19.5 dB with a half power beamwidth of approximately 8 degrees. The full array, 47.5 feet long (**diagrams 'J' plus 'J-1'**) is nearly 17 wavelenths long, and it has a gain according to diagram 'K' of 21.5 dB and a half power beamwidth of approximately 6 degrees. The important thing to remember here is that we are looking at gain and half power beamwidths over **all** of high band or channels 7-13. We can do this because of the design of the feed system. Two such arrays will produce respectively 19.5

plus 2.8 dB or **22.3 dB of forward gain** (for the 22 element version) or 21.5 plus 2.8 dB or **24.3 dB of gain** for two of the 41 element versions. Stacking four of the 41 element arrays will produce 21.5 plus 5.5 dB or 27 dB of forward gain. This is right up there in the rhombic antenna class (**see CATJ for October 1976**)!

Just to set everything in perspective, this is the type of gain you would achieve if you stacked or phased say 200 dipole arrays. The problems associated with matching and phasing that many dipole arrays would of course be extra-ordinary. But of even greater importance, when you are working in a deep fringe area, the area where you find signal is often no more than 30 feet high by 30 feet wide. Since gain-addition only comes when all of the fed elements of a multiple stack array are receiving relatively coherent (i.e. in phase) incoming wavefront signal, it follows that to "build" large signal voltages in areas where signals are low, and spotty, you have to "squeeze" as much gain into the "hot area" (such as 30 feet by 30 feet) as possible. Antennas falling **outside** the area where there is consistent signal circumstances actually degrade the performance of the full array.



REPLACE THE 22-1/2 ELEMENT ON THE FRONT OF THE 22 ELEMENT SURFACE WAVE ANTENNA WITH A 23 IN. ELEMENT AND ADD THE ABOVE ARRAY TO THE FRONT END OF IT WITH 24 INCH SPLICE AS SHOWN IN DIAGRAM K-2.

DIAGRAM J-1

Installing The Big One

Start off with a test antenna of known (gain) directivity. Make measurements over the full area to determine (1) the width, (2) depth and most important the most productive heights (above ground) for the incoming wavefront. Repeat the tests when there are several different types of weather along the path from the

BOOM SPLICE/ADDITION OF 19 DIRECTORS TO 22 ELEMENT ARRAY

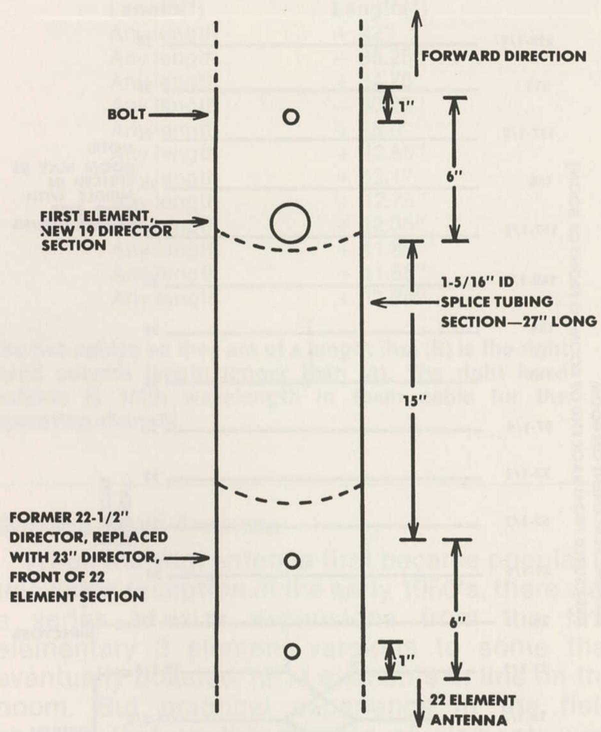


DIAGRAM J-2

DRIVEN ELEMENTS—SIDE VIEW

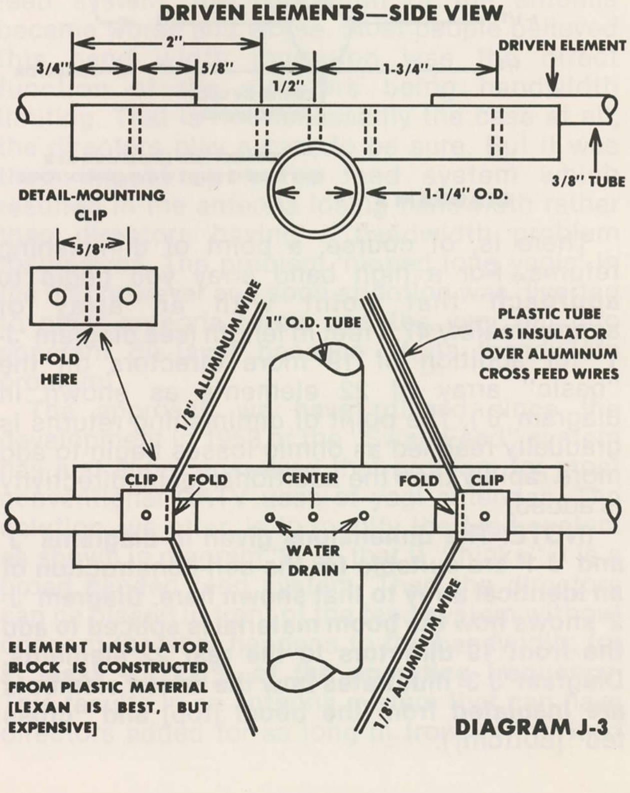


DIAGRAM J-3

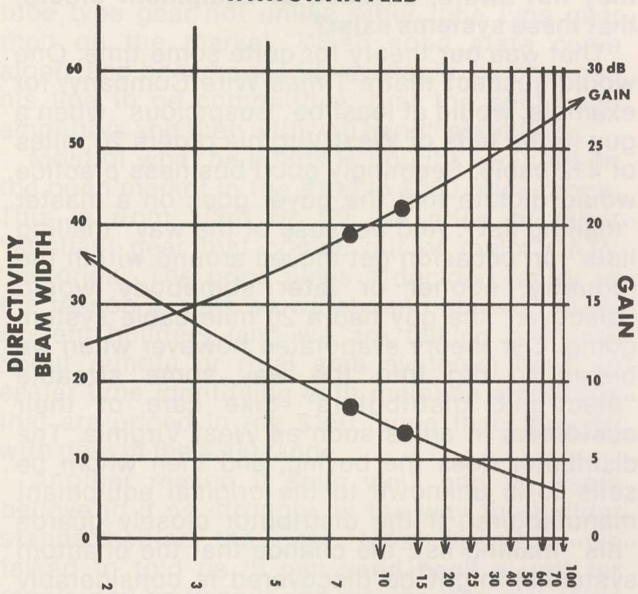
transmitter to your selected receiving site. Put stakes in the ground so you can return to the same exact spots and heights for later verifications of the signal levels. Repeat the tests at several different times of day.

The key is to put the antenna (whatever antenna) **where the signal is!**

(For the record, Swan says that with two of the long arrays stacked he can see an increase in background noise when the sun is directly in front of the array. That translates in a 4.5 MHz bandwidth to a fairly decent antenna gain figure and an unusually low background noise level from manmade and terrestrial sources.)

If the signal wavefront tends to move around abit, two (or more) antennas can be stacked in such a way that after your antenna site tests have narrowed down the area in which the signal moves around, you can place an antenna in both (or each) of the "hot spots" to allow the antennas to "track" (as in diversity) the wandering signal **(diagram 'L')**.

SURFACE WAVE GAIN WITH SWAN FEED



LENGTH IN 1/2 WAVES
DIAGRAM K

Support

The best (and perhaps least expensive) support system for these long arrays will be a set of two or three metal telescopic poles. Swan utilizes a system similar to that shown in **diagram 'M'** on most of his Arizona and New Mexico installations. Because of the high forward directivity of the array it must be anchored so as to not move around from side to side (wind blowing the array will create a form of buffeting that will translate to signal fading as the array moves left and right of dead-on the incoming wavefront). The array needs to be grounded and Swan says that by installing 3 foot metal lightning rods at the **top** of the masts and running grounding wires down the masts to **driven ground rods** he has never had a lightning problem; nor has he ever lost a pre-amplifier.

The array has a "match" of from 18 to 28 dB typically and the gain is +/- 1 dB of the total over the full frequency range from channel 7 through 13. Within any single channel, sweep tests indicate the match is within +/- 1/4 dB and gain variation is virtually not measureable.

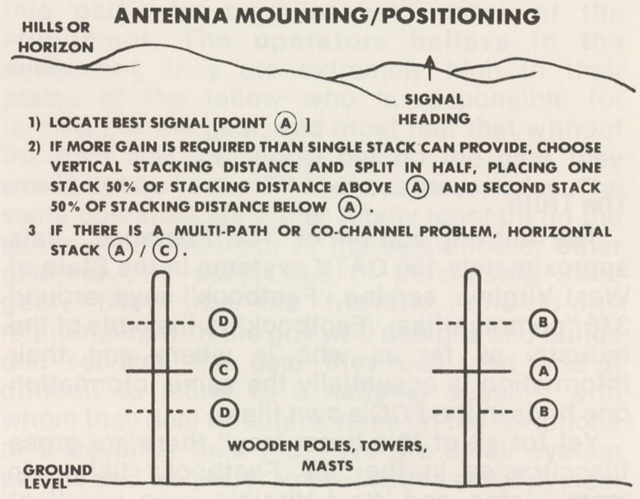
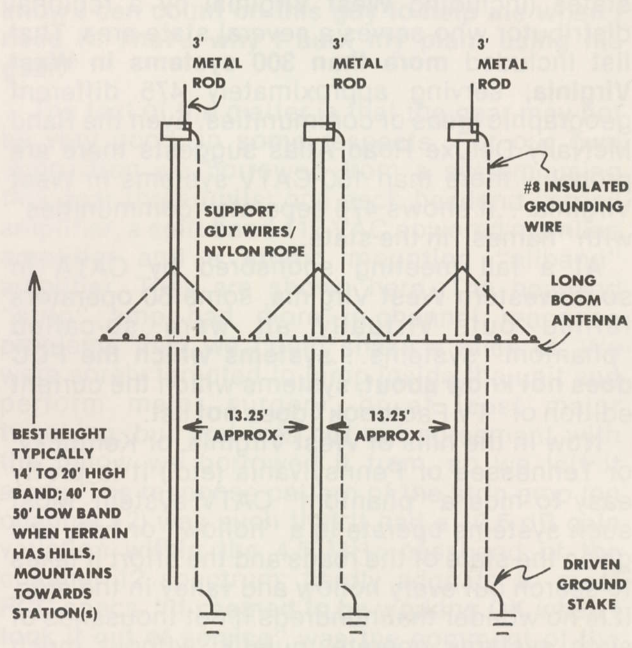


DIAGRAM L

HANGING UP A 40 FOOT BOOM HIGH BAND ANTENNA



OLIVER SWAN REPORTS "I HAVE NEVER LOST A PRE-AMP TO LIGHTNING USING THIS METHOD OF ANTENNA MOUNTING".

DIAGRAM M

FINDING OLIVER SWAN

Readers interested in pursuing the electronic packages or antennas discussed in CATJ this month will be able to locate Oliver Swan as follows:

Mr. Oliver W. Swan
Swan Antenna Company
P.O. Box 5378
Bisbee, Arizona 85603
602-432-5526

CATJ Looks At. . .

A 'NO—NAME' AMPLIFIER LINE IN WIDE USE IN APPALACHIA

The Truth. . .

The current edition of "TV Factbook" lists approximately 150 CATV systems in the State of West Virginia; serving, 'Factbook" says, around 375 "communities. "Factbook" is the bible of the industry as far as who is where and their information is essentially the same information one finds in the FCC's own files.

Yet for all of this "accuracy" there are gross inaccuracies in the "TV Factbook" listing in many states, and West Virginia is an excellent exception. More than a year ago CATA (Community Antenna Television Association) was given a list of "CATV systems" in several states (including West Virginia) by a regional distributor who serves a several state area. That list included **more than 300 systems in West Virginia,** serving approximately 475 different geographic areas or communities. Even the Rand McNally Deluxe Road Atlas suggests there are probably more than 150 CATV systems in West Virginia. . .it shows 476 separate "communities" with "names" in the state.

At a fall meeting sponsored by CATA in southwestern West Virginia, some 60 operators turned out. Virtually all were so-called "phantom" systems. . .**systems which the FCC does not know about,** systems which the current edition of "TV Factbook" does **not** list.

Now in the hills of West Virginia, or Kentucky, or Tennessee or Pennsylvania (etc.) it is pretty easy to hide a "phantom" CATV system. Most such systems operate in a "hollow" or two, and given the state of the roads and the effort it takes to search out every hollow and valley in the area, it is no wonder that hundreds if not thousands of such systems operate, quietly, without much outside knowledge. But there are similar systems in virtually every state, including we are finding right here in Oklahoma or neighboring Kansas. One would suspect that such small, phantom systems are by-in-large serving perhaps 50 or 100 customers; and for the most part **that is** true. But it is not totally true. The FCC, because of a sloppy error on the part of the system operator, uncovered a previously unknown 2,200 subscriber system in eastern Tennessee this past fall. And at least one of the operators attending the CATA meeting in West Virginia had more than 2,000 subscribers on **his** "phantom" system. Often one operator or "operating company" will have well over a 1,000 subscribers on two or more systems, operating from hollows spread over one or more counties in an area.

The plain truth is that there are systems operating, perhaps as many as 1,500, which neither the FCC or "TV Factbook" is aware of. But what about the equipment suppliers? Are they not aware, because of equipment orders, that these systems exist?

That was **our** theory for quite some time. One would suspect that a Times Wire Company, for example, would at least be "suspicious" when a guy in the hills of West Virginia orders 20 miles of 412 cable. Seemingly good business practice would dictate that the buyer goes on a master "mailing list". And because of the way "mailing lists" on occasion get moved around within the industry, sooner or later somebody would "discover" the guy had a 20 mile cable system going. Our theory evaporated however when we began to dig into the way some sizeable "electronic distributors" take care of **their customers** in areas such as West Virginia. The distributor does the buying, and then whom he sells to is unknown to the original equipment manufacturer. If the distributor closely guards "his" mailing list, the chance that the phantom system(s) might be discovered is considerably diminished.

"But" we reasoned "everyone has a problem from time to time with electronic equipment, and sooner or later somebody who wants to remain quiet is going to have to come out of his shell to get assistance for a sick amplifier or for warranty repair". Well, we were wrong again. We hadn't reckoned with "regional manufacturers" of CATV gear.

As noted previously in this issue of CATJ, there are probably a handful of "Oliver W. Swans" out there building gear primarily for themselves, and perhaps for a few others around them. If you are like Oliver Swan, and only purchase cable, if you deal through a distributor who doesn't re-circulate his lists hither and yon, **you can keep your identity pretty well hidden.** It follows that if there is a guy or two out there like Swan who "likes building gear", **quietly,** for operators in his area, there might even be a few outfits that have received no national attention (because they want to keep themselves hidden as suppliers) who "service" the phantom market with equipment.

It turns out that there are several like this; and one of the biggest of these "quiet, almost clandestine" manufacturers of equipment operates out of West Virginia where in the past 15 years or so he has supplied thousands and thousands (you read that number right) of pieces of headend gear and line amplifiers. His market extends over several states, including systems from Tennessee to southern New York State. His gear, or a few pieces of it, is the subject of our report.

Hill Country Amplifiers

The "manufacturer" of the equipment shown here prefers to remain "hidden". We won't violate that desire. The gear is heavily utilized throughout several states, and may in fact account for as much as **30% of all of the CATV gear** in the "home state" of West Virginia, currently in use.

The first gear he turned out, years ago, was tube type gear not unlike other tube type gear then on the market. When solid state came along, and became readily available, he changed his line to be competitive; first the split band amplifiers and then with "all band" amplifiers.

Most of what he builds is bought and sold on the open market in the $100 to $200 price range. This is from 1/3rd to 1/2 the price of other "similar" gear that comes out of major CATV 'factories'. The price plays a decided factor in the reason it sells so widely and so well. Rural system builders (and we are talking primarily about remote or rural **area** systems) have an easier time identifying with mainline amplifiers that are priced in the $150 range than they do with gear in the $300 range.

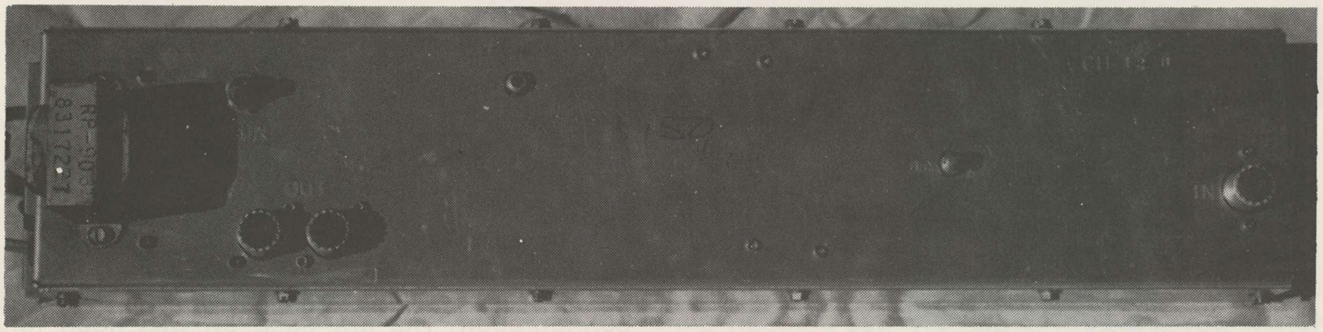
Another reason it sells well, and its users believe in it so strongly, is the way the builder stands behind the gear. Most operators we talked to told us **"I can send back a unit for repair, and he fixes it and returns it to me, often in a few days time and usually with no repair charges".** This may be the nearest thing to an unlimited warranty that the industry has today.

A third reason small system operators buy this equipment is terms. Numerous small operators told us **"He will let me have the gear on time payment and when I need more amplifiers all I have to do is to call up and order them. There is never any hassle over paying for them. . .he knows I will just as soon as my new 'TV line' gets some customers on it. . .".** The friendly 'country store' attitude of the whole transaction seems to keep the users coming back for more gear.

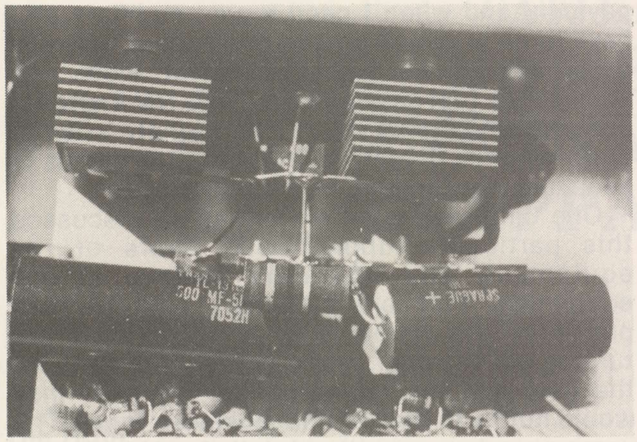
One thing was most evident as we discussed this particular supplier with users of the equipment. **The operators believe in the equipment,** they are extremely high in their praise of the fellow who is responsible for turning out the gear, and most feel that without the gear and the fellow behind the gear **they would not be in the 'TV line' business today.** The same operators are either totally ignorant (in the sense of uninformed) of the existence of **other** gear, or very suspicious of purchasing other gear. They like the friendly, one-on-one relationship with the guy who **designs** and **builds** and **services** the gear they use; and find it difficult to relate to a national supplier with whom they deal through a voice on the telephone or a traveling field rep. **"We are small system people and we prefer to deal with a small system supplier"** said one operator.

"I know this is not the best gear on the market" remarked another system operator who had been exposed to other equipment **"but I know I can count on this guy to help me when I need it. That's why I built my plant using his gear."**

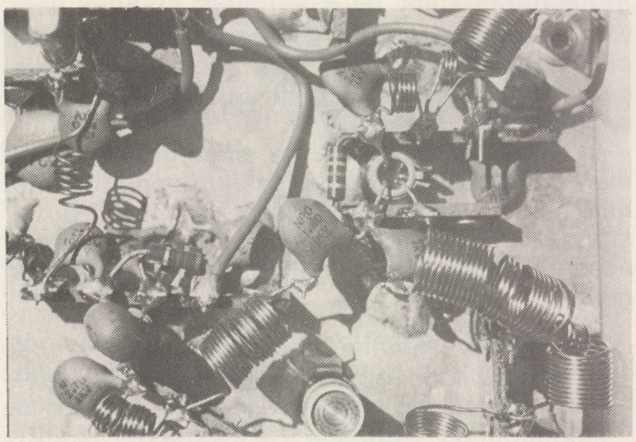
The fact of the matter is that the gear **may** not be very good, in **some** respects. For our own instruction we borrowed from a system using this gear three units; one each headend "strip" amplifier, a split-band 117 VAC powered mainline amplifier and a strand mounting "allband" amplifier. They are shown here. The headend "strip" amp had more in-channel response problems than **we** could shake a stick at. We were sorely tempted to jump inside the unit and perform major surgery, or at least major **tweeking,** but that was **not** our agreement with the fellow we borrowed it from, so we left it alone. The response pattern of the strip amp (on channel 12) was such that it had a 10.5 dB gain variation **within** the 4.5 MHz passband of the channel 12 spectrum; hardly adquate to meet FCC specs. **"It seemed to be working OK when I took it out of service"** was the comment of the



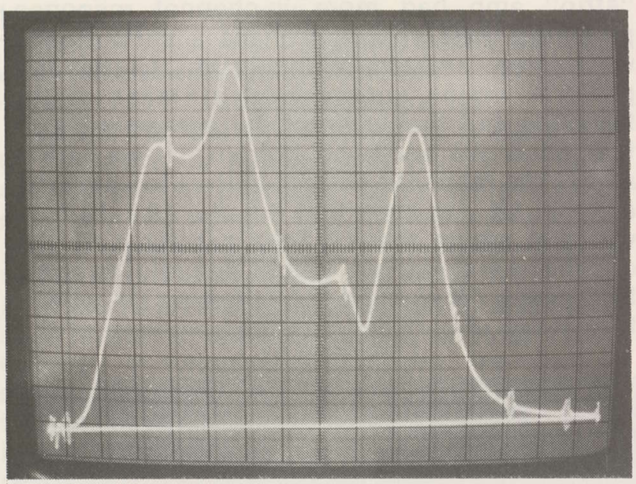
HEAD END STRIP AMPLIFIER is primarily a gain block (around 60 dB) with gain control, standby carrier but no AGC.



SELENIUM RECTIFIERS were major 'surprise'. In an era of silicon diode rectifiers, selenium devices have all but disappeared in the rest of the world. Their failure rate is better that tube type rectifiers but cannot approach reliability of silicon diodes; they are primarily low voltage devices (up to 130 volts RMS) and for currents under 1 amp.



PLENTY OF POINT TO POINT construction in Hill Country amplifiers, careful choice of new parts and adequate heat sinking of solid state devices.

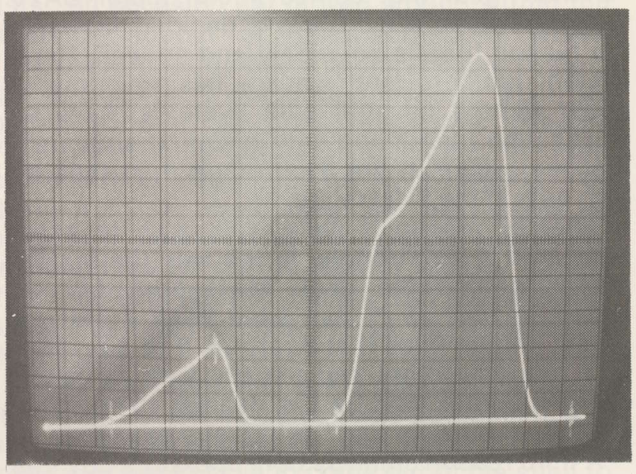


HILL COUNTRY STRIP AMPLIFIER frankly would have a difficult time meeting FCC specs (it might even have a hard time meeting viewer acceptance). Channel 12 strip had bad 10 dB peak to valley response variations within 205.25 to 211.75 MHz region. Worst drip in response occurs between 209 and 210 MHz region or right in color sub carrier region of channel.

fellow who loaned it to us. 'OK' was probably a relative term; the operator did not have the capability of sweeping gear so he had no **real** way of knowing what the response might look like. We measured the gain at between 59 and 60 dB and noted that the unit got into inter-mod problems when the output ran up higher than +55 dBmV output.

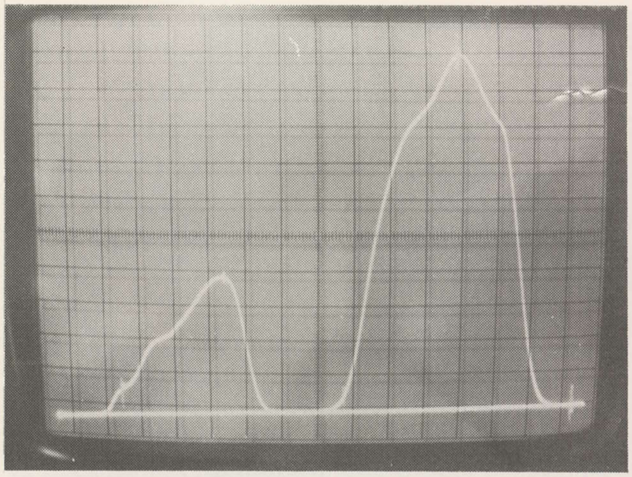
Not having sweep capabilities is no crime of course. . but it is part of the problem with any gear that is not run through a series of final check out tests. We decided that many of the "Hill Country Amplifier" units are probably providing something less than FCC—compliance service and specifications, and operators may well be experiencing problems which a sweep test would pin down in a big hurry. However, a system that relies on $150 mainline amplifiers is probably not about to jump out and spend $500 for a sweep generator and another several hundred dollars for a display system. So it becomes a vicious circle.

The construction of all of the 'Hill Country Amplifier' equipment was, frankly, **very good.** We were impressed with the quality of the parts (we couldn't find any use of non-standard parts and the parts utilized seemed to be straight out of any commonly available major-brands parts catalogue; **the builder does not skimp on parts) and we were impressed with the quality of the construction.** There was nothing backwards about the point to point layouts, careful use of heat sinks and general craftsmanship. **The builder knows what he is doing, and he does it well.**

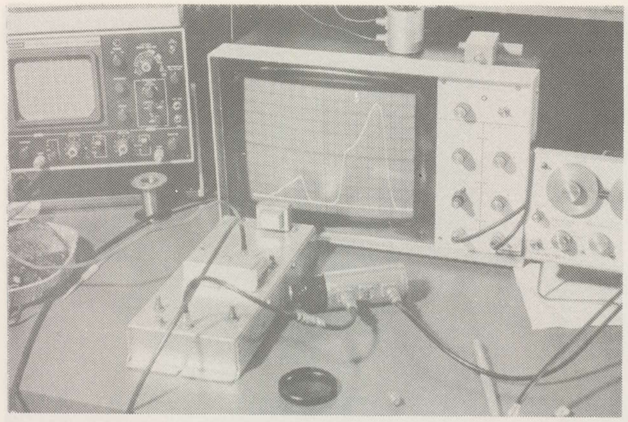


HILL COUNTRY SPLIT BAND amplifier with both low and high band segments adjusted for maximum tilt within each band. High band has 11 dB more gain than low band in this state of adjustment and tilt within high band is approximately 4 dB.

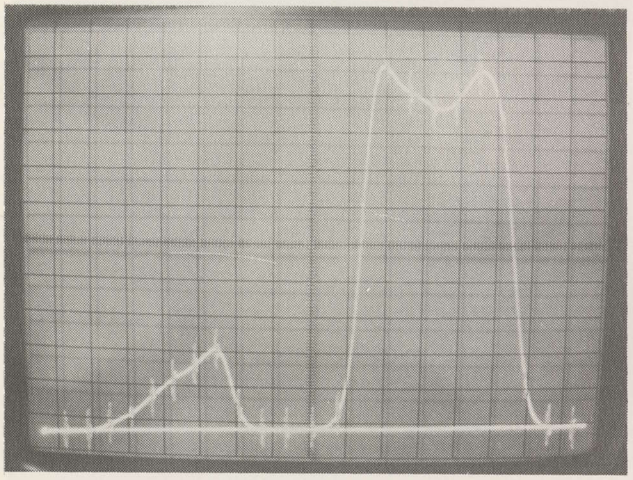
The model A213 "split band" amplifier had separate gain and tilt controls for both low and high band. We found the low band gain control amounted to about 1 dB of change, and then only in the last 10% (counter clockwise) of the pot. This may have been a peculiarity of the unit we inspected. High band gain was about 11 dB higher than low band, resulting in a 32/43 dB gain configuration. The low band tilt was good for around 6 dB of range (i.e. the low end of low band



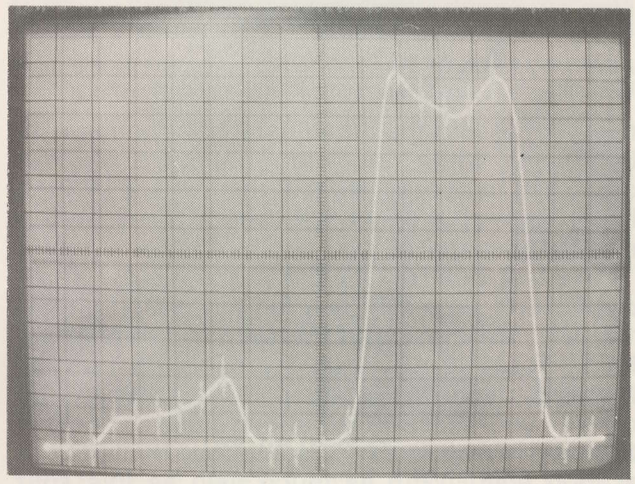
HILL COUNTRY SPLIT BAND amplifier at output test point. We found the isolation was 22 dB at 100 MHz and 24 dB at 200 MHz. "Bubbles" are evident in test point response and do not track with a direct look at output of amplifier.



HILL COUNTRY SPLIT BAND AMP undergoing sweep test. Low band response (left on screen) and high band response right.

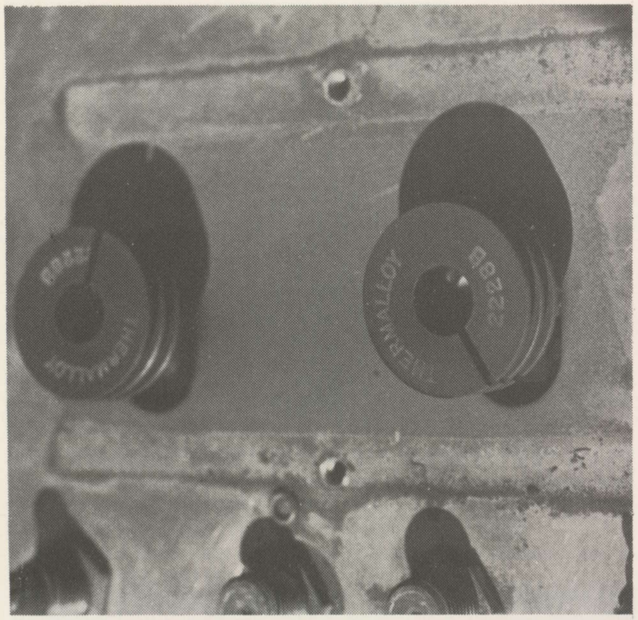


HILL COUNTRY SPLIT BAND amplifier with +10 dBmV flat and low band tilt adjusted for maximum tilt, high band segment adjusted for least tilt.



HILL COUNTRY SPLIT BAND amplifier looking at output port directly. Input was +10 dBmV flat. Display is of low band segment and high band segment with 10 MHz markers; both of the respective "tilt" controls adjusted for flatess possible response.

SPLIT BAND AMPLIFIER has separate gain and tilt controls for low and high band, input and output test points.



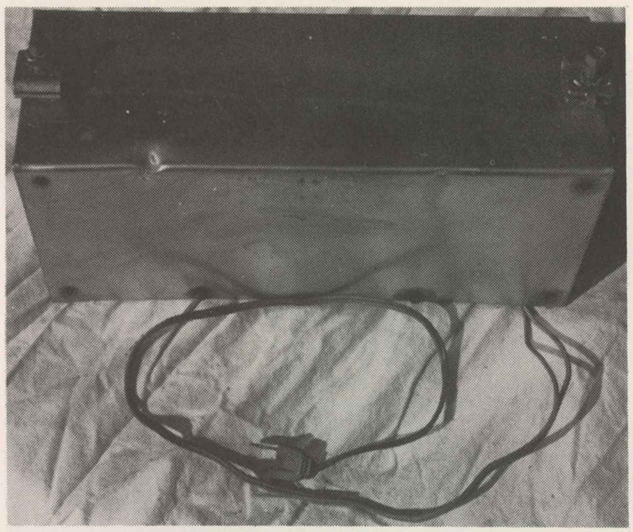
AGAIN NO LACK OF QUALITY to design approach; adequate heat sinks on output transistors in split-band amplifier.

raised 6 dB with the tilt adjusted for minimum in-band tilt) while the high band tilt control corrected to about 4 dB (i.e. the low end of high band came up 4 dB to meet the level of the top end of high band).

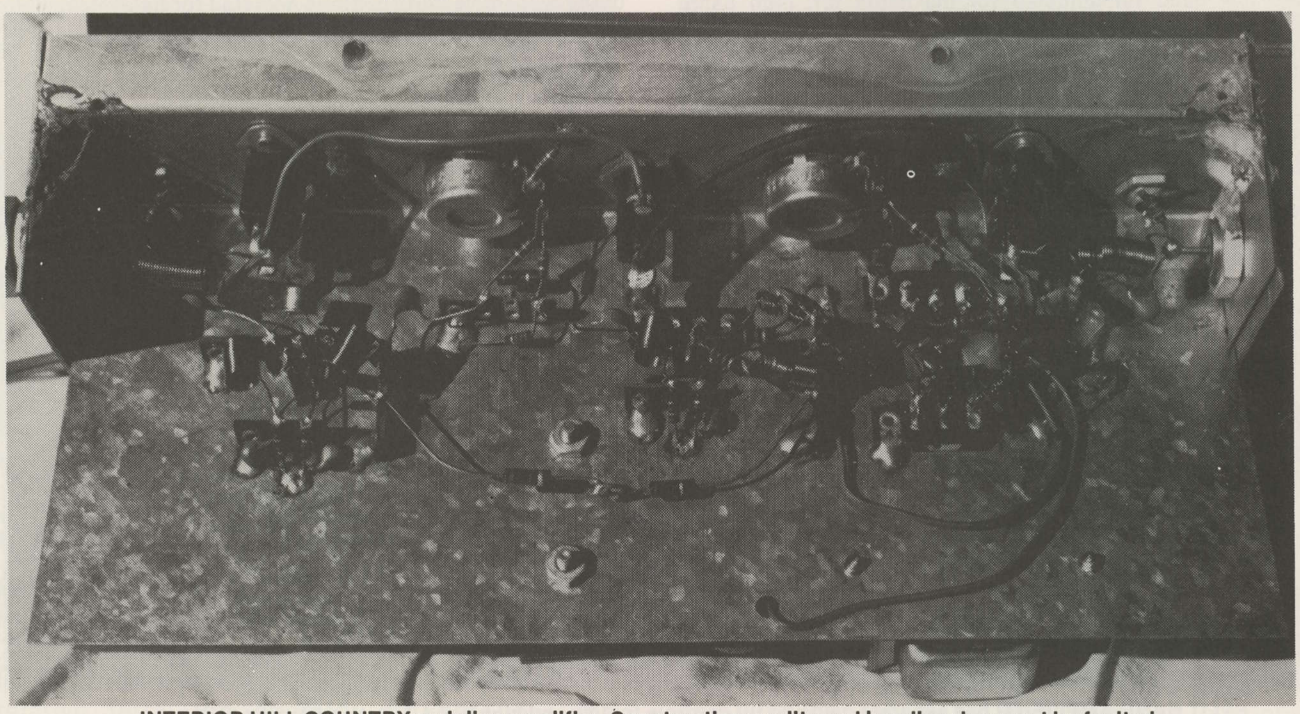
The test points, which are marked as 20 dB **down** ports, were off by a fairly wide margin. At 100 MHz we measured the **output** test point as being down 22 dB while the same port at 200 MHz was down 24 dB. Again, it is no crime to be off with your test port isolation values but 4 dB at 200 MHz is a bit much for somebody trying to run a good plant. With as much gain as this split band amplifier has, being off a couple of dB in the output test port might make a considerable difference to someone attempting to maintain parity between the "rated output specification" (before cross mod) and what a signal level meter indicates.

The "allband" solid state unit had an interesting set of tilt responses when coupled with the gain measured. Gain at 50 MHz was 11 dB, gain at 100 MHz was 16 dB, gain at 175 MHz was 20.5 dB and gain at 214 MHz was 26 dB; when the unit was adjusted for maximum tilt. The **input** test port was down 23 dB at 100 MHz and 26 dB at 200 MHz; again a substantial difference from the real world. The **output** test port tracked on the low side; down 16 dB at 100 MHz and 18 dB at 200 MHz. The combination of **low reading inputs** and **high reading outputs** could be an operational problem.

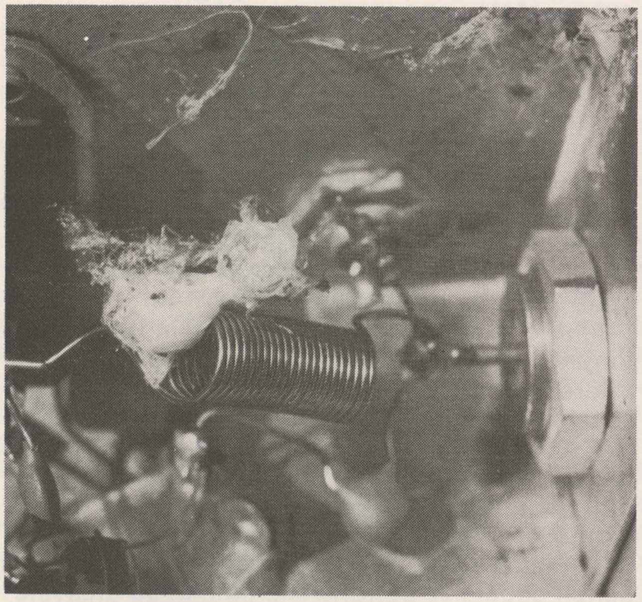
Our purpose here is not to criticize or critique a low cost, apparently well received amplifier line that has found wide acceptance in the



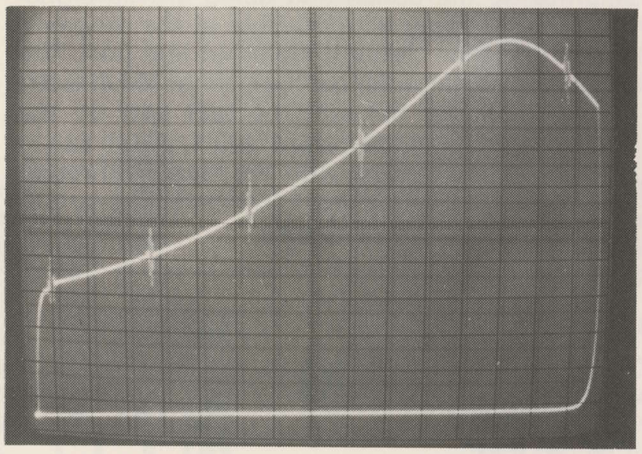
HILL COUNTRY strand supported mainline amplifier is housed in formed sheet aluminum housing.



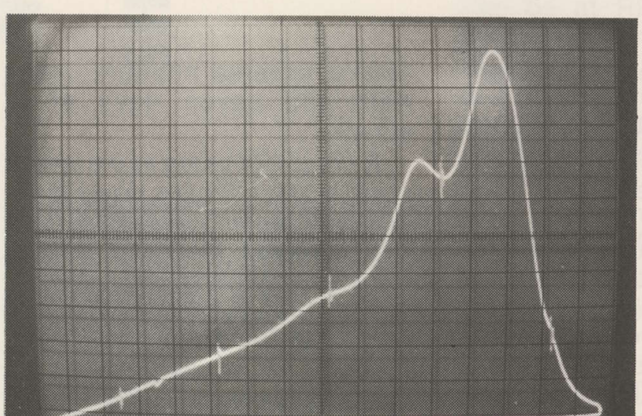
INTERIOR HILL COUNTRY mainline amplifier. Construction quality and handiwork cannot be faulted.



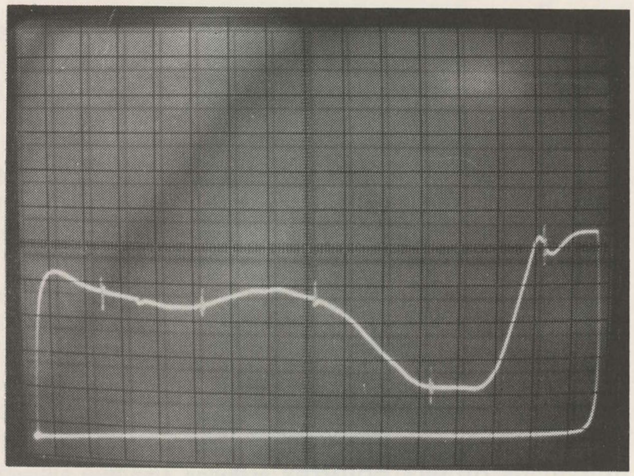
WE SAW NO SIGNS OF WATER SEEPAGE in the mainline amplifier, but at least one 'critter' managed to get inside and leave behind her 'time capsule' for more critters (left hand side of coil)!



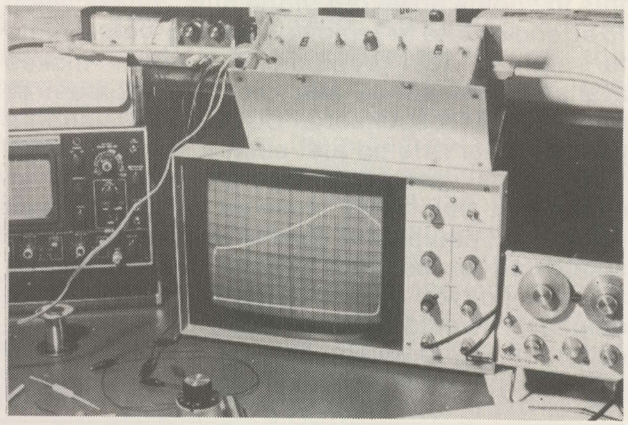
HILL COUNTRY HIGH BAND SEGMENT of mainline amplifier had 5.5 dB of "in-highband-tilt" between 174 MHz and 213 MHz peak of response (markers at 10 MHz intervals; 170 MHz far left).



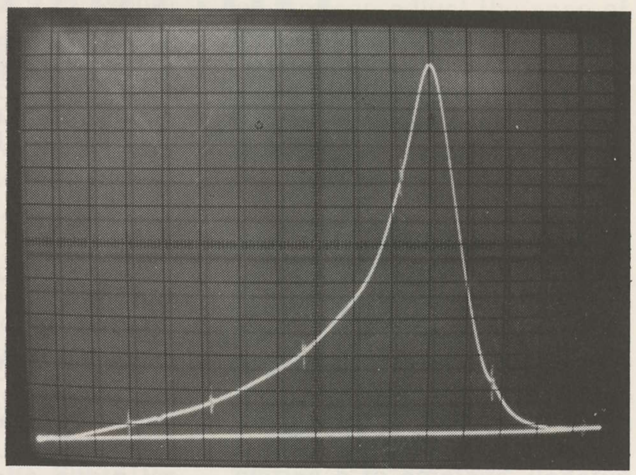
HILL COUNTRY OUTPUT TEST PORT shows moderate lack of linearity; isolation at 214 MHz was measured at (-) 18 dB. "Bubble" just above 200 MHz (marker 3 divisions right of center on screen) is in test point, not amplifier response.



HILL COUNTRY INPUT TEST PORT shows lack of linear response. Far left marker is 50 MHz, progressing in 50 MHz steps to 250 MHz (right). Measured test point isolation is 21 dB at 250 MHz, 26 dB at 200 MHz and 23 dB at 100 MHz.

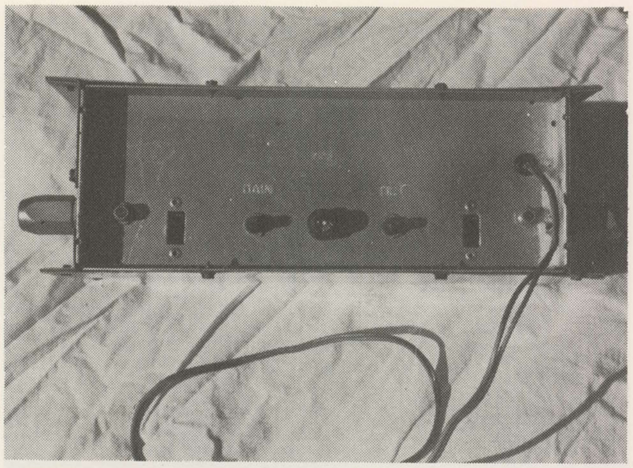


HILL COUNTRY MAINLINE AMP undergoing sweep test (high band portion of response shown with 10 MHz markers). Sweep source is Wavetek 1801A and display is Wavetek 1901B big screen unit.



HILL COUNTRY FULL TILT with 50 MHz markers (50 MHz far left, 250 MHz down slope on far right) indicates amplifier had in excess of 12 dB of tilt from 50 MHz to 213 MHz (peak gain response); input +10 dBmV flat.

Appalachia region. You fellows using this gear know better than anyone else what you can afford to install and what you can't; and where you have to cut corners to make cable service practical in low (home) density regions. Rather, our purpose is to suggest that there is a need, we



UNDERSIDE OF HILL COUNTRY mainline amplifier shows test points, gain and tilt controls and fusing plus AC plug connections.

believe, for operators using equipment such as this to "come down out of the hills" on occasion to attend a state or regional meeting where some far sighted test equipment supplier makes available **test bench analysis** of equipment in use. The CATA sponsored CCOS-76 session this past summer offered just such a session in our 'Lab Room' sessions. Operators brought in equipment which was checked out on the 'Lab Room' test equipment. Such a session has been **suggested for the West Virginia area this spring;** a weekend-two day session where the **main emphasis** would be on equipment analysis, calibration, and sweep testing. We happen to believe that such sessions should be a part of every state and regional CATV operator's meeting, and we further believe that if the people planning these state and regional meetings were to plan such 'open door' technical analysis sessions, and if the sessions were staffed with test equipment people who know how to quickly analyze the working characteristics of a piece of equipment brought in from the field, such sessions would prove to be excellent drawing cards for operators who normally stay away from state and regional meetings.

In the instant case, operators in the West Virginia, Kentucky, Virginia area who would be interested in attending such a specialized session are encourage to communicate with CATA Region 3 Director **David Fox** (P.O. Box F, Gilbert, West Virginia). Fox is currently looking into holding just such a session during the month of May at a West Virginia location; and CATA and CATJ will provide suitable lab or bench people to perform the **no-charge analysis** of any equipment brought into the meeting.

In the meantime, even without sweep test equipment, you can verify your own input and output test port accuracies by simply taking an amplifier to the bench and using a drop signal check the reading with an SLM at the drop-end proper and then through the input test port. The output of the amplifier can be connected directly to the SLM (not through the **test port** on the output) to arrive at the output levels, which can in turn be cross checked with the reading **through the output test port** (always terminate the output port when making this check).

CATJ Lab Report

THE TOMCO ADS-1000 FAMILY OF NON—DUP SWITCHERS

Freeing Tired Hands

Ever since the FCC got into our act one of the major problems regulation has created for system operators is application of the various and often confusing rules regarding "non-duplication". In a nutshell, systems of a certain size (over 999 subscribers) and in certain locations (inside of the 35 mile circle for major markets and inside of the 55 mile circle for minor markets) are required to provide "local" stations with protection from simultaneous cable-showing of programs that are also available on other cable channels.

In the early days of this exercise, cable people invested a few bucks in twenty-four hour time clocks and laboring with set-screw-adjustable mechanical stops attempted to make their "distant" channels flip on and off the cable at the predetermined points in time. This proved to be an unsatisfactory system so the industry came to our rescue with every imaginable form of diode and mechanical switcher. Many of these, developed in the late 1960's, covered multiple channels and seven days at a whack.

A couple of years ago a small outfit down in Texas developed an "automatic" switcher unit that sampled the sync pulses from two stations and when it found the sync signals "in sync" performed a switching function. Unfortunately, the integrity of **some** broadcast sync signals leaves something to be desired, even when stations are "on line" for a live network feed and there was a discomforting amount of "false switching" with the unit. It never received national acclaim and perhaps that is just as well.

During the past year there have been rapid advancements in IC technology, and some of these advancements have had a direct bearing on the ability of a design engineer to re-look at the non-duplication switcher problem. The folks at TOMCO Communications, Inc. have done just that in recent months and the result is a new approach to automatic non-duplication protection.

The concept for the ADS-1000 series of automatic non-duplication switchers from TOMCO is not unlike the approach taken by the fellow down in Texas a few years ago; except that rather than comparing sync integrity between two stations, the ADS-1000 series of switchers compares the audio integrity between two stations. It works this way.

Human speech has a pattern; the pattern is identifiable and measurable. When a person says "audio" his voice creates a particular form of audio wave which has identifiable characteristics. These characteristics can be displayed on a scope screen (as in an audio spectrum analyzer) and they can be measured and "patterned" electronically in an IC circuit. When a network television program is sent down "the line" to television stations, and the program is the same to all stations, it follows that within small fractions of a second the audio will sound the same **(and measure the same)** coming from both stations at the same time. The ADS-1000 "looks at" the utterances coming along the TV station's audio circuit and compares **those** utterances electronically with the utterances coming through a **second** channel or station **at the same time.**

Because there is **some** audio path delay between two separate stations, it follows that if the ADS-1000 had to see **absolute** correlation between two different sets of audio, there would be few occasions where there would be totally instantaneous identical comparison between the two audio signals. So the ADS-1000 builds in a "weighting circuit" that allows from 10-20 milliseconds of time difference between the two audio utterances; a period during which if audio "A" compares with audio "B" the ADS-1000 machine assumes there is identical audio data present (and as a consequence it functions as if the two station signals were identical). It works out that such a 10-20 millisecond delay is necessary since the audio feed circuit from the network "dispatch" point is often routed circuitously and there may well be an extra 500 or 1,500 miles of audio circuit "delay time" built into the audio circuit between two stations that are but 100 miles apart as the crow flies.

Any Headend

The ADS-1000 family of automatic non-duplication switchers will function with any conceivable headend combination. You have inside of the box the guts of two separate "receivers", the IC comparator circuitry and some switching circuits. The RF input can be from any commonly available source, such as a heterodyne processor, a microwave fed modulator, or a strip amplifier. The input signal can be at RF (i.e. the cable carriage channel) or it can be at i.f. (looped out of a heterodyne processor). Video directly from a microwave demodulator (with 4.5 MHz sub-carrier audio) may also be used for the input to the ADS-1000 unit.

The idea is that you have two separate inputs to the ADS-1000. The inputs represent the two channels which you have to monitor; one is a "primary" (or protected) channel while the second is the "secondary" (or distant) channel. The ADS-1000 is available with 12 channel turret tuning at one or both input positions, which simply means you dial up the channel(s) involved and set a couple of controls. The RF section goes through a mixing chain that results in a 4.5 MHz signal with audio present. The audio signals are processed in a device known as a "phoneme detector". There is a squelch control in the audio line so that noise does not "fool" the phoneme detector into falsing.

The ouput of the phoneme detector is a square wave which can be digitally processed for comparison with a "match counter". Signals "A" and "B" are compared for "sync" and if there is "sync" between the two audio derived signals the automatic switching circuit functions to switch off the duplicating distant signal. The circuitry has been designed so that there can be as much as 10-20 milliseconds of time delay between the two audio signals without effecting the "simultaneous" comparison circuitry and the circuit also has a counting mechanism that requires an extended period of "non-comparison" before the unit decides that there is not "sync" between the two, thereby returning the two channels to their own separate programming. The CATV system can adjust the span of time between "non-sync" and "switching" with an (optional)

TOMCO ADS-1000 SPECS

General - An automatic non-duplication switcher with Phoneme Comparator circuit for audio "sync"

Inputs - Available with RF, I.F. or video inputs

Switching - Will switch through external relays or through internal RF or I.F. or video switching

Input Levels -
I.F. from heterodyne - +25 dBmV
Video - 1 volt peak to peak
RF - +10 dBmV

Maximum Path Differentials -
2,000 miles

Switching Time/on-off -
20 seconds to 4 minutes, adjustable

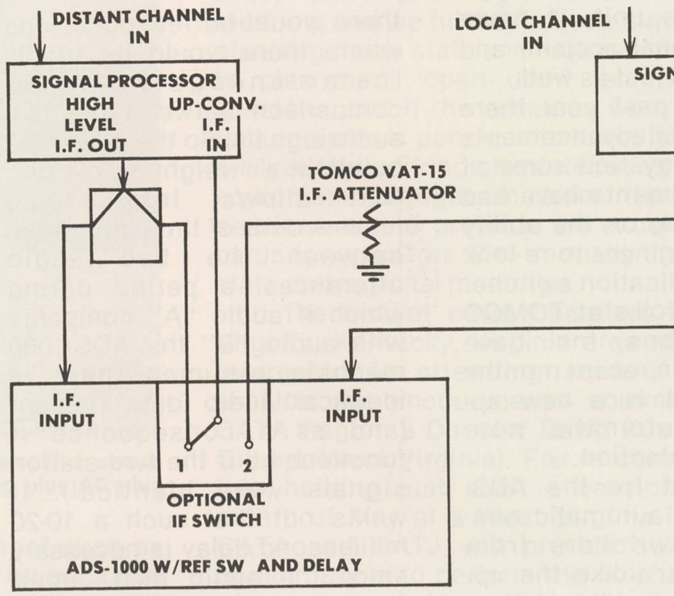
Manufacturer -
TOMCO COMMUNICATIONS, INC.
1077 Independence Avenue
Mountain View, California 94043
(415/969-3042)

Price Range -
$1,000 (varies with options)

delay adjustment pot mounted on the rear panel. The "switching time" is typically 20 seconds (i.e. after there is no longer "sync" between the two audio signals, the switching will take place in 20 seconds time) and is adjustable up to about 4 minutes time. This means that if you are switching the local channel signal onto the distant channel on the cable (so as to maintain pictures on the affected channel for the folks at home) you can adjust the unit so that during those "quickie" network station breaks of say 30 seconds length the local station stays on the distant channel cable channel for the full network break period.

Very Versatile

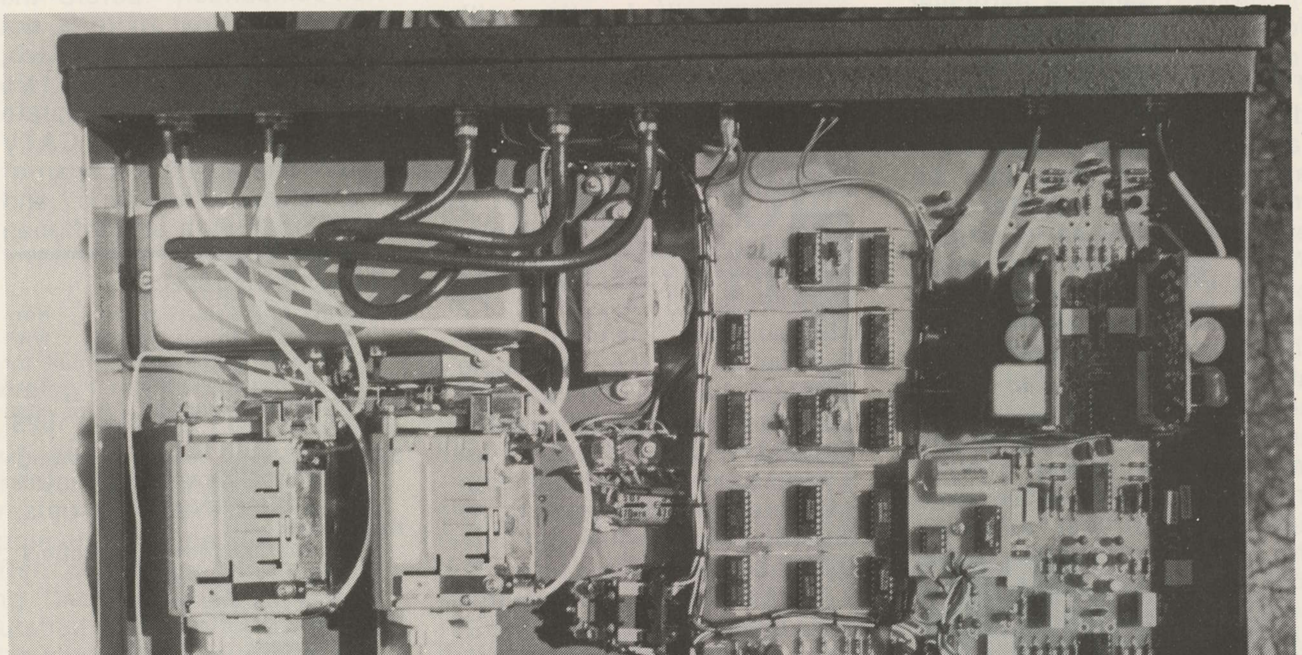
The ADS-1000 family of automatic non duplication switchers is, like most TOMCO products, very versatile. In addition to the many different forms of input possible (RF, IF and video from a demodulator), there is a host of switching options available. One of these



1 WHEN INPUTS ARE DIFFERENT THE I.F. SWITCH REMAINS IN POSITION 1

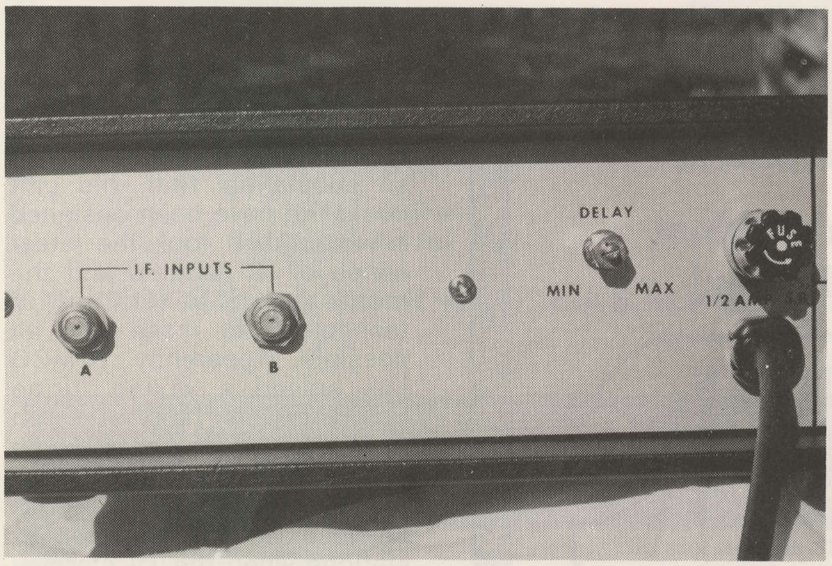
2 WHEN INPUTS ARE IDENTICAL THE I.F. SWITCH GOES TO POSITION 2 THE OUTPUT OF THE LOCAL CHANNEL APPEARS AT THE OUTPUT OF THE DISTANT CHANNEL.

3 THE I.F. ATTENUATOR SHOULD BE ADJUSTED SO THE OUTPUT LEVEL OF THE DISTANT SIGNAL PROCESSOR IS THE SAME AS WHEN THE DISTANT CHANNEL IS ON.



INSIDE THE ADS-1000 unit shows twin RF tuners (left), switching units (center) and complex IC circuitry for Phoneme Comparator (right of center).

ADS-1000 SERIES switcher unit has host of inputs and I.F. inter-connection cable ports on back apron, as well as external control switching connections and time delay (optional) adjustment pot.



packages is shown here in diagram form. You can:

(1) Use the ADS-1000 switching circuitry to simply turn off the output on a duplicating channel (thereby leaving the channel blank or with a standby carrier on);

(2) Use the ADS-1000 switching circuitry to I.F. switch the I.F. output from the local channel heterodyne processor to the I.F. input on the distant channel heterodyne processor (thereby keeping the distant cable channel 'lit' with the local channel signal);

(3) Use a pair of ADS-1000 units to cover two distant channels and one local channel (switching in at I.F. or simply switching off the distant channels);

(4) Use the ADS-1000 to switch off the ouput of a strip amplifier, or, take the output of a modulator (with local weather or whatever) and switch it in as a replacement for the distant channel;

(5) Use the ADS-1000 to switch off the distant channel and switch in a "wild card station/-channel".

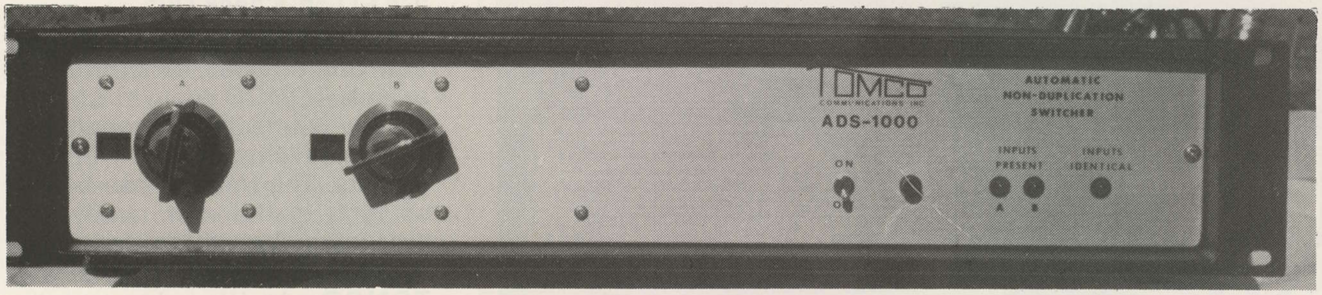
There are probably other switching applications you can handle with the ADS-1000; suffice to say that if you can dream them up, the engineers at TOMCO can probably figure out how to make them happen.

'CATJ Lab' Check-Out

When we first learned of this new unit last fall we promptly asked TOMCO if we could borrow a unit long enough to do an evaluation of it for readers. The interest has been so high in the new family of switchers that it took several months for Vince Borelli at TOMCO to juggle some shipping schedules to get us a unit even for a week's time. As it turned out the unit we looked at was being shipped down to Texas anyhow and it kind of passed through here on the way to Texas.

In all honesty, there is not much you can say about the unit if it works like it is supposed to work. **It did.**

As the photos show, the construction is straight out of the TOMCO "good book" of "how to build a neat, modern, solid state CATV headend unit". The unit rack mounts, and if it is an RF input unit (as ours was) it has a pair of 12 channel tuners built in on the far left side. They are labeled, appropriately, "A" and "B". There is a power on and off switch on the front panel and a set of LED Lights. An "A" LED light blinks to indicate that there is audio activity on the channel; as does the "B" LED. A third LED, marked "Inputs Identical" lights only when there is parity or "sync" between the two inputs. Using a two-way splitter, you can check this portion of the package out by routing the same input signal to both inputs. It takes from 10-20 seconds for the "Inputs Identical" LED to fire, and another 10-20 seconds for the "Identical" light to go out after the inputs go out of sync. The **optional** time delay circuit is factory set for 90 seconds time, which means with that option the "Identical" light stays on (and the switching holds off) for 90 seconds time (or up to 4 minutes) after the signals no longer compare. The switching connection terminals on the



TOMCO ADS-1000 SERIES AUTOMATIC NON-DUPLICATION SWITCHER (see text)

back apron are set for an open circuit when there is non-parity bewteen the two input signals; the contacts "short" or close when the signals have "sync". This is where the switching devices connect if external.

We set the unit we received up on several different parallel programmed channels at the CATJ Lab and found that it works like it is supposed to work; when the signals were in sync, it provided switching and when they were not, it shut down.

In talking with Tom Olson about the unit prior to receiving it for check-out, Tom allowed as how the advances in IC units during the past year have been so substantial that this unit could not have been designed a year ago. It took the latest series of IC gadgets and the most recent generation of technology to make this all possible. Apparently TOMCO has solved a vexing, tiring problem which has been with us in one form or another since the mid 1960's. Gone forever are the long, drawn out battles between cable systems and TV stations when the TV stations fail to provide adequate advance program protection data or listings. Gone also is the frustration of having sporting events chopped off in the final minutes of play or long movies removed from the subscriber's screen just as the exciting climax is about to occur. One indication of how good a thing TOMCO has going is the rapid dispatch with which the new units are finding their way into the field. Another is the recent announcement by another company of an almost identical unit (at the recent Texas show). They say imitation is the sincerest form of flattery. . .and Tom Olson should be flattered to see one of his company's creations copied so quickly!

Noise Is Not Noise?

"Reference the new LENCO box for measuring signal to noise ratios (pages 26-33 January CATJ). This is a neat new box, but let's not confuse the issue of the actual type of noise we are supposed to be measuring to make FCC compliance. There are three main noise sources on pictures delivered via cable:

1) Head end gear (i.e. noise contributed by noise figure)
2) System amplifiers (again, noise figure x gain=noise added)
3) Noise on the received signal itself

It is my understanding that FCC tests are required for items 1 and 2 but not for 3. I feel the FCC wants to know the signal to noise ratio of the received signal to system created noise within a 4 MHz bandwidth.

To use the LENCO box described in January you will have to demodulate the RF signal to video first.

If you use a handy demodulator (i.e. an SLM with a video output), you have two problems: The limited bandwidth of the SLM i.f. and the S/N of the meter itself (which is probably worse than the 36 dB FCC spec). So to use the LENCO unit to measure video signal to noise (which would then have to be translated through a conversion chart or set of tables to RF signal to noise) you will need to add-on to the package a portable high quality demodulator. I can't happen to think of any on the market at the moment.

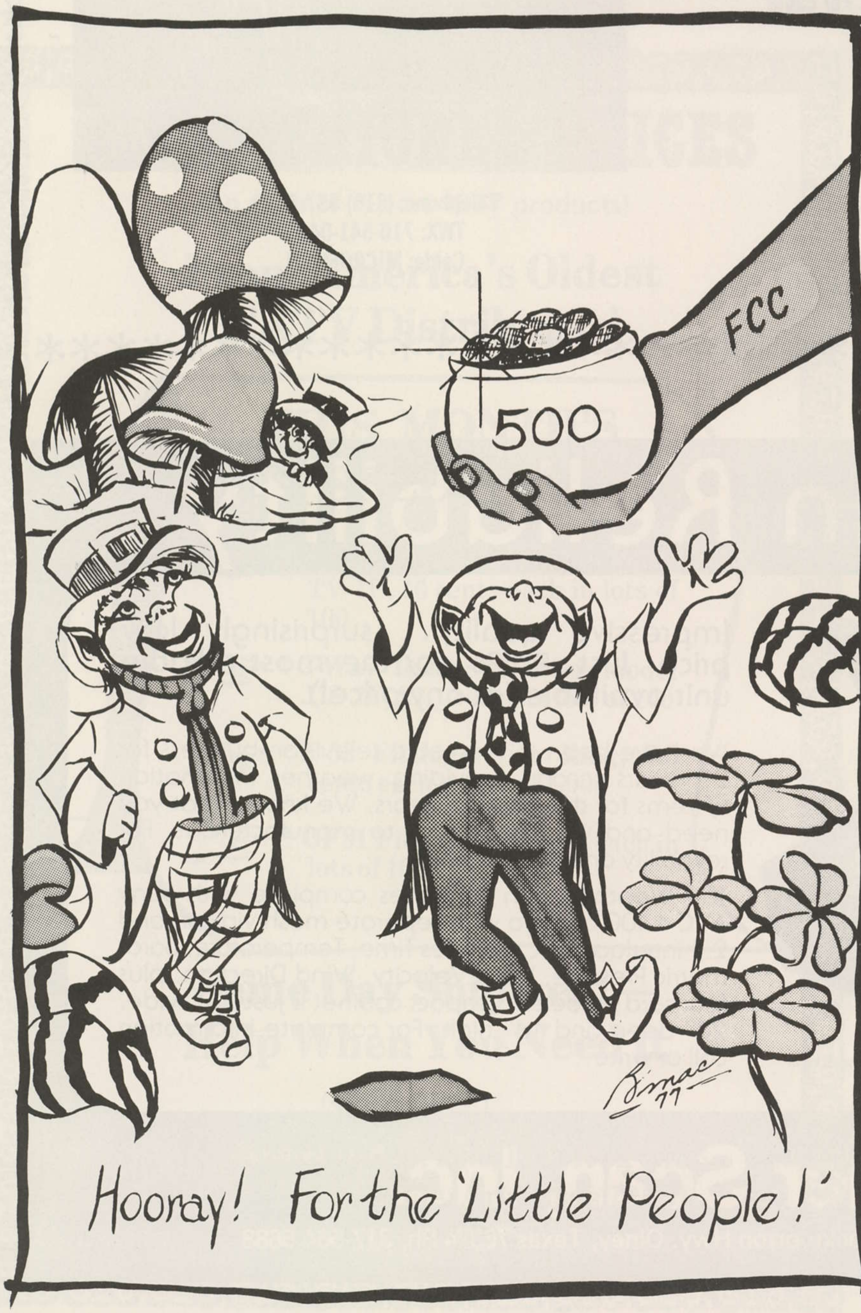
In summary, the LENCO technique is a super technique but I believe more suited to large systems and especially those systems that have microwave feeds or make use of their own microwave systems."

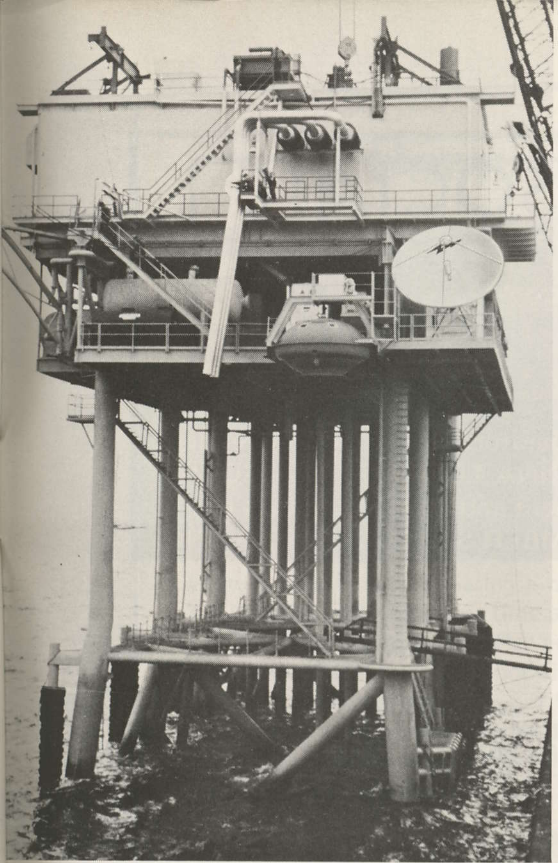
Lawrence C. Dolan
Mid State Communications, Inc.
Beech Grove, Indiana
46107

Larry -

You make several excellent points which the fast reader of the January issue may have overlooked. Number one is that this is not a replacement technique for SLM RF signal to noise measurements in most **situations. This whole thing started in the November CATJ when we pointed out that even the most sophisticated spectrum analyzers cannot properly read RF signal to noise when the ratios are up there above 40 dB. Even the region from 36 to 40 dB is of** questionable **accuracy. . .the irony being that when you have** lousy **signal to noise ratios** (i.e. less than the 36 dB required for signals first picked up within their Grade B contour), **you can measure it and quite accurately at that. It is when you approach the FCC's magic 36 dB ratio that available equipment and techniques fall apart.**

Your point concerning what-it-is the FCC wants has been glossed over for too long. We discussed this with Bob Powers at the FCC more than a year ago and he told us the same thing you suggest: i.e. the FCC wants to know what the ratio is between your **RF signal voltage** and your **system noise** at your **test drop.**

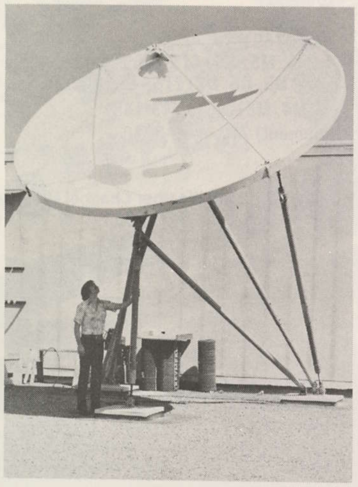




Offshore Drilling Platform

Parking Lot

Remote Location in Alaska



Building Rooftop

ANDREW 4.5 METRE EARTH STATION ANTENNA PREFERRED FOR HUNDREDS OF APPLICATIONS

Offering excellent performance, versatility, ease of transportation and quick installation, even in difficult locations, the Andrew 4.5 metre earth station antenna has proved to be the right choice for hundreds of applications.

If you are planning a 4.5 metre earth station installation, place your reliance on Andrew's experience and market acceptance. Contact your Andrew sales engineer, or ask for Bulletin 1094.

ANDREW

ANDREW CORPORATION
10500 W. 153rd St., Orland Park, IL., U.S.A. 60462
Telephone: (312) 349-3300

ANDREW ANTENNA COMPANY LTD.
606 Beech St., Whitby, Ontario, Canada L1N 5S2
Telephone: (416) 668-3348

ANDREW ANTENNAS
Lochgelly, Fife, Great Britain KY5 9HG Telephone: (0592) 780561

ANDREW ANTENNAS
171 Henty St., Reservoir, Victoria, Australia 3073
Telephone: (03) 460-1544

ANDREW ANTENAS LTDA.
Av. Victor Andrew, 585, Caixa Postal 600,18100 Sorocaba—SP—Brasil Telephone: (0152) 28900

cata ASSOCIATE MEMBER ROSTER

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

Andrew Corp., 10500 W. 153rd St., Orland Park, IL. 60462 (**M2, M3, M9** Satellite Terminals) 312—349-3300
Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 (**D1**) 206—624-0505
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**) 408—249-0700
Belden Corp., Electronic Division, Box 1327, Richmond, IN. 47374 (**M3**) 317—966-6661
BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 (**M1, M2, M4, M5, M6, M7**) 201—679-4000
BROADBAND ENGINEERING, INC., 535 E. Indiantown Td., Jupiter, FL. 33458 (**D9, replacement parts**) 305—844-2458
CALIFORNIA MICROWAVE, INC., 455 West Maude Ave., Sunnyvale, CA. 94086 (**M9 Satellite Terminals**) 408—732-4000
CATEL, 1400-D Stierlin Road, Mt. View, CA. 94043 (**M4, M9**) 415—965-9003
CCS HATFIELD/CATV DIV. 5707 W. Buckeye Rd., Phoenix, AZ. 85063 (**M3**) 201—272-3850
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA. 16801 (**M1, M4, M5, S1, S2, S8**) 814—238-2461
COMMUNICATION EQUITY ASSOCIATES, 8200 Normandale Blvd., Suite 323, Bloomington, MN. 55435 (**S3**) 612—831-4522
COMM/SCOPE COMPANY, P.O. Box 2406, Hickory, N.C. 28601 (**M3**) 704—328-5271
ComSonics, Inc., P.O. Box 1106, Harrisonburg, VA. 22801 (**M8, M9, S8, S9**) 703—434-5965
DAVCO, INC., P.O. Box 861, Batesville, AR. 72501 (**D1, S1, S2, S8**) 501—793-3816
EAGLE COM-TRONICS, INC., 8016 Chatham Dr., Manlius, N.Y. 13104 (**M9 Pay TV Delivery systems & products**) 315—682-2650
FARINON ELECTRIC, 1691 Bayport, San Carlos, CA. 94070 (**M9, S9**) 415—592-4120
FEDERAL BROADCASTING CO. 600 Fire Rd. Box 679 Pleasantville, N.J. 08232 (**D9, S9**)
FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX. 75652 (**S1, S2, S7, S8, S9**) 214—854-2405
GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ. 85063 (**M7**) 602—272-6871
HOME BOX OFFICE, INC., 7839 Churchill Way—Suite 133, Box 63, Dallas, TX 75251 (**S4**) 214—387-8557
ITT SPACE COMMUNICATIONS, INC., 69 Spring St., Ramsey, N.J. 07446 (**M9**) 201—825-1600
Jerry Conn & Associates, 550 Cleveland Ave., Chambersburg, PA. 17201 (**D3, D5, D6, D7**) 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
LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 (**M7**) 607—739-3844
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 (**M1**) 315—682-9105
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 13057 (**M5, bandpass filters**) 315—437-4529
MID STATE Communications, Inc. P.O. Box 203, Beech Grove, IN. 46107 (**M8**) 317—786-9537
MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 (**M9 Digital Video Equip.**) 801—262-8475
OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL. 60014 (**M1, M9 Converters, S3**) 815—459-5000
PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA. 95050 (**M2, M3, M7, S2**) 408—244-4720
Q-BIT Corporation, P.O. Box 2208, Melbourne, FL. 32901 (**M4**) 305—727-1838
RICHEY DEVELOPMENT CORP., 1436 S.W. 44th, Oklahoma City, OK. 73119 (**M1, M4, M8, S8**) 405—681-5343
RMS CATV Division, 50 Antin Place, Bronx, N.Y. 10462 (**M5, M7**) 212—892-1000
Sadelco, Inc., 299 Park Avenue, Weehawken, N.J. 07087 (**M8**) 201—866-0912
Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA. 30340 (**M1, M2, M4, M8, S1, S2, S3, S8**) 404—449-2000
SITCO Antennas, P.O. Box 20456, Portland, OR. 97220 (**D2, D3, D4, D5, D6, D7, D9, M2, M4, M5, M6, M9**) 503—253-2000
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ. 85036 (**M3**) 602—268-8744
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 (**M8, bandpass filters**) 317—357-8781
Theta-Com, P.O. Box 9728, Phoenix, AZ. 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML MICROWAVE**) 602—944-4411
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**) 203—265-2361
Titsch Publishing, Inc., P.O. Box 4305, Denver, CO. 80204 (**S6**) 303—573-1433
Tocom, Inc., P.O. Box 47066, Dallas, TX. 75247 (**M1, M4, M5, Converters**) 214—438-7691
TOMCO COMMUNICATIONS, INC., 1132 Independence Ave., Mt. View, CA. 94043 (**M4, M5, M9**) 415—969-3042
Toner Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA. 19044 (**D2, D3, D4, D5, D6, D7**) 215—675-2053
Triple Crown Electronics, Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W 2Z3 (**M4, M8**) (461) 743-1481
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, automated ladder equipment**) 712—262-5810
VITEK ELECTRONICS, INC., 200 Wood Ave., Middlesex, N.J. 201—469-9400
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**) 317—783-3221
WEATHERSCAN, Loop 132 - Throckmorton Hwy., Olney, TX. 76374 (**D9, Sony Equip. Dist., M9 Weather Channel Displays**) 817—564-5688
Western Communication Service, Box 347, San Angelo, TX. 76901 (**M2, Towers**) 915—655-6262/653-3363

NOTE: Associates listed in bold face are Charter Members

Distributors:	Manufacturers:	Service Firms:
D1—Full CATV equipment line	M1—Full CATV equipment line	S1—CATV contracting
D2—CATV antennas	M2—CATV antennas	S2—CATV construction
D3—CATV cable	M3—CATV cable	S3—CATV financing
D4—CATV amplifiers	M4—CATV amplifiers	S4—CATV software
D5—CATV passives	M5—CATV passives	S5—CATV billing services
D6—CATV hardware	M6—CATV hardware	S6—CATV publishing
D7—CATV connectors	M7—CATV connectors	S7—CATV drop installation
D8—CATV test equipment	M8—CATV test equipment	S8—CATV engineering


THE ONLY TAP
OF ITS KIND
27
db
MOISTURE SEALED &
CORROSION RESISTANT