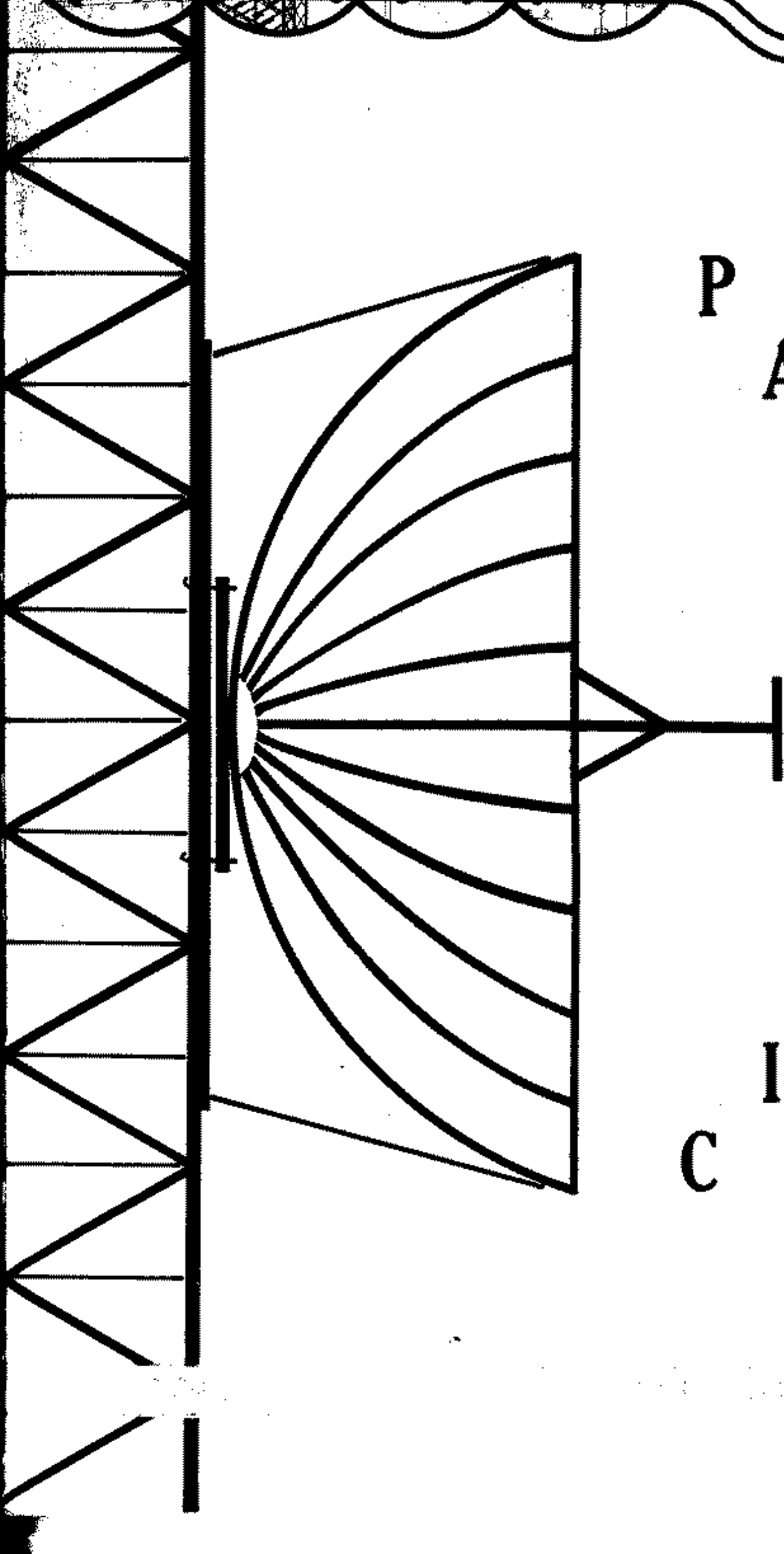
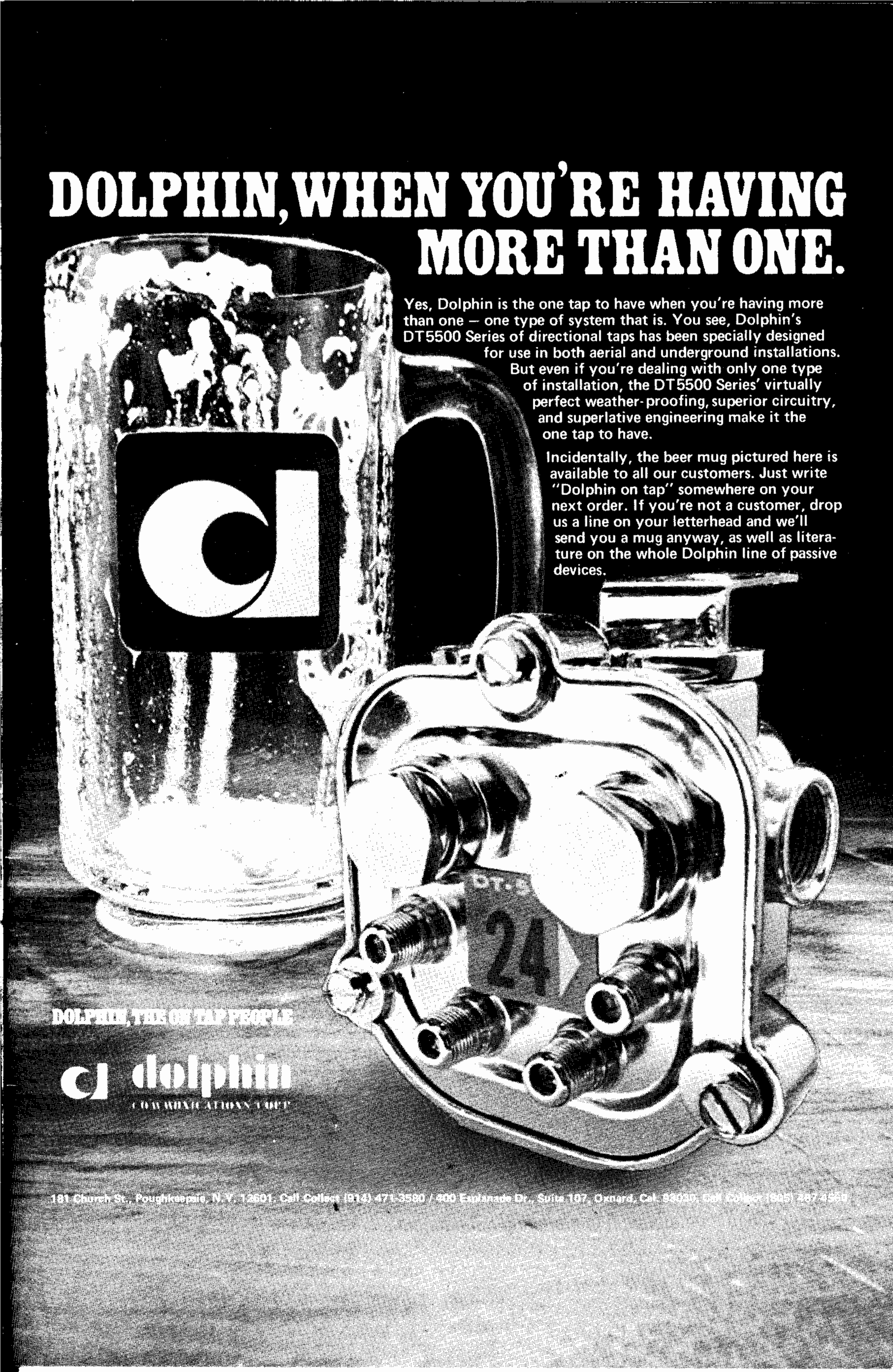
CATJ

JULY 1974



# PARABOLIC Antenna Operations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P. O. Box 18904, Oklahoma City, Oklahoma 73118

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**SUBJECT**: Surplus CATV test equipment at CADCO

**ACTION DESIRED**: Buy it now before anyone else does!

At the time of our recent fiscal year-end inventory, we took a careful look at the test equipment in use, and sitting around not in use. We found there was quite abit of the latter. Now we have written this test equipment down (ie. depreciated it) every month. And now we have decided that it is better to sell it for its depreciated value than to continue blowing dust off of it every month. So we offer it for sale on a first-payment-received .... sold basis.

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| T112354 | Sweep Gen | Wavetek | 1801 | 0-900 MHz, 54 MHz markers | 12/72 | $1166.04 |
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**LIKE-NEW** *CATV TEST EQUIPMENT* **SALE!!!**

CATJ

# JULY

VOLUME 1
NUMBER 3

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## —CONTENTS—



**OUR COVER**

CATJ's reputation for treating subject matter in great detail is exemplified this month with the most comprehensive single report ever published on virtually any type of CATV off-the-air antenna, in this case, the mighty parabolic (Page 6).

# CATA -TORIAL

KYLE D. MOORE, President of CATA,INC.

**Whipping A Live Horse**

The Senate (full) Judiciary Committee has finally met and considered the matter of releasing to the full Senate bill number S.1361, a revision of the existing copyright laws in this country.

On the thin chance that you may not be aware how it went, allow this synopsis:

The copyright fees were cut 50%; so now the low end of the scale is 1/2% of gross revenues to be paid into the **copyright bank** for systems grossing less than $40,000.00 per 90 day (quarterly) period.

And, that teeth shattering sports blackout provision has been dropped. **Totally.**

The NCTA calls this a "victory". CATA does not.

The NCTA is taking full credit for **defeating** the bill in the form it left the sub-committee. **We** raise the question of whether the NCTA deserves the credit for defeating the bill. Or, whether they deserve to be blamed squarely for getting us into a position where we were open for this kind of idiotic viewer-taxation in the first place.

There is no question that NCTA went all out to get the blackout provision lifted out of the bill. There is considerable **speculation** as to why it was included in the bill that left the sub-committee in the first place.

My grandpappy used to tell me how he prevailed on a land developer during the 1940's not to put in a large housing development right across the road from his wheat acreage. The land developer had tried to buy grandpa out of his wheat acreage for a depressed price. When that failed, he went across the section line and bought 160 acres from a fellow that needed the money badly. Then the developer proceeded to start advertising his 1/3rd acre plots with all of the usual promises of roads, water, sewer and so on. My grandpappy pondered for a week or so, and then went out and erected himself a huge sign on his acreage facing squarely into the 160 acre tract the developer was putting in. On the sign he printed the following:

"COMING SOON — One of the World's Largest Hog Farms, on this Site"

The developer quietly took down his signs and the land is still agricultural today, 30 years later.

I believe the sports blackout bill provision was nothing more nor less than a Hog Farm sign. No one intended that the CATV industry would lose their rights to sporting events. Not even Bowie Kuhn (the baseball czar) really thought they had a chance to make it fly.

But, my oh my, how that diverted our attention away from the **real issue** at stake, **paying copyright fees!** And rather than mustering an industry wide grass roots program to combat the payment of a **viewing** tax, we had our attention diverted to the (obviously) more important question of **losing our sporting events!**

And it worked. Sure, we got a 50% reduction of the copyright fees. But just how long do you think that 1/2 of one percent rate will stand? Once passed into law, it can and will be changed very quickly by the administrators of this big new federal agency that will spring up to administer this law. I stand on my rising social security and employer contributions to employee benefits programs as proof that 1/2 of one percent will not be 1/2 of one percent very long!

Did **NCTA** gain that reduction of 1/2% for the industry? Again, I think not. I think **CATA** can take the lions share of the credit for that one. Because last December we filed a formal report with Senator McClellan which was a study initiated at the Senator's request. The subject of the study was detailed analysis of the ability of the smallish CATV system(s) to pay a 1% copyright fee as then proposed.

CONTINUED - bottom page 5

# CABLE CAPTIONS

**Gentle reminder department —** with this third issue of CATJ, those thousands upon thousands of FREE **sample copies** we have been distributing comes to an end. No panic, if you are a **paid-up** subscriber. But after this fine issue you are now reading, unless you have a subscription to CATJ, you will receive no more.

**Now you may have** been receiving more than one copy per month. As readers subscribed, we tried to purge the master mailing list (i.e. our original lists) to remove duplicated names, but many on the free sample listing are in company names, and many, or most of you subscribing, are doing so in your own names. So our sharp eyed gals just don't catch them when they are listed differently. However, that also should settle down to just one copy per month for you, **as a paid-up subscriber,** effective with the August issue.

**Speaking of the August issue** (that is called a segue in the broadcast biz) it will be a corker. Remember all of that blue sky jazz you have been reading about satellites transmitting programs to CATV head ends, direct? You may have seen the Scientific-Atlanta/TelePrompter demonstration in Los Angeles last summer, or elsewhere since. If you asked the price of the earth receiving station being towed around by TPT, you were probably told "in excess of $100,000 ". Well, CATA and CATJ have broken the price barrier on earth receiving stations. Rather than $100,000. per site, we are talking around (we estimate) $1,500.00 per site for a complete antenna plus receiver for a 2.6 GHz earth receiving terminal for the newly launched ATS-F satellite now beaming regular ETV type broadcasts to six different areas of the United States. Not only will this be a new channel for your system, but it will also be an excellent opportunity for your CATV system to make a lot of points with the local residents and town council. There has got to be one heck of a lot of interest in your showing off an earth receiving terminal for satellite broadcasts in your town.

**The Kentucky CATV Association** came out in their March-April-May newsletter with a complete endorsement of the CATA copyright stance; i.e. systems performing traditional antenna-to-cable-to-home relay functions should not be liable for any copyright payments. **Period.** The Kentucky group further went on record with their Senators and Congressmen as being totally opposed to any inclusion of CATV in the omnibus copyright bill (S. 1361).

**Arthur "Skip" Kraus,** of Seneca Cable TV, headquartered in Joliet, Illinois, reminds us of a solution to a sticky problem all installers face: how to explain bonding or grounding of a CATV drop. As "Skip" notes, many customers want to know everything you are doing as you run a drop and as you are installing a grounding block the obvious question posed to the installer is "......you mean I might get struck by lightning????". Obviously once that prospect is raised in the subscriber's mind that lightning might travel around on the drop cable, you **have** got problems! "Skip" says he just tells people that he is installing a **radiation suppressor** and that usually stops the fellow dead in his tracks. Well done "Skip".

**Quote of the month:** After the "victory" for anti-copyright people at the Senate Judiciary Committee on June 11th, NCTA rushed out an ego inflating self-congratulatory letter (see **CATA-torial** this issue). After patting everyone on the back several times, NCTA's hard working Prexy Foster noted **"To be sure, the copyright matter is not over"**. That we agree on, David!

---

CATA-torial continued

The Senator requested the study, and we knew the minute he got it that he was sorry he ever asked for it. This study showed so clearly that small CATV systems are, as a group, losing money that **no-one would ever dream of adding even 1% gross receipt taxes** onto such a system. We did not circulate the study widely, because we felt it was highly confidential, but it did see the light of the press in a few publications, in abbreviated form, such as **Broadcasting** magazine, and that was enough to sway some important decision makers.

But we are not very proud of the job that report did, because rightfully we owe no viewing tax, at all. The big push is still ahead of us. If and when the matter sees the light of day in the Senate, we will have an opportunity to amend or defeat the bill. Barring that, we still have the House of Representatives, which we consider more practical than the Senate in this matter.

**The horse has not completed his race,** nor is he dead or dieing. Hang in there . . . . . the finish line is still ahead!

# USING THE PARABOLIC FOR DISTANT OFF-THE-AIR SIGNALS

**IN THE BEGINNING**

Anyone involved in radio transmission or reception sooner or later has a "*love affair*" with antennas. It is inevitable. And at some point during that romance, the *bigger is better* syndrone takes hold. As one digs deeper and deeper into the magical world of elements, stacking, array size, pattern and DB forward gain, one inevitably crosses paths with the parabolic (or dish) antenna.

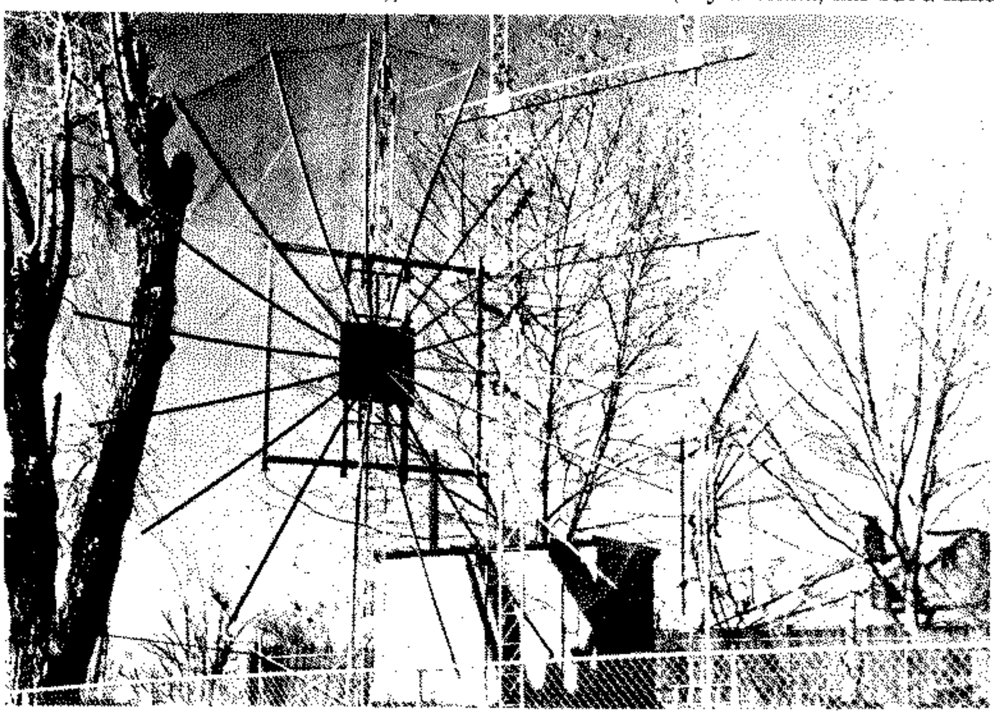
It is hard to circulate in the world of TV reception and *not* have at least a recognition of parabolic or dish antennas. They are commonly utilized for UHF reception (4,6, 8 and 10 foot dishes are not uncommon), and in many areas of Canada and the United States one finds modified parabolic design antennas installed for long haul VHF (and UHF) reception.

People are naturally intrigued by their size. The *bigger is better* syndrone is never more evident than with a 200 foot parabolic dish!

The premise for this report is a guarded acceptance that bigger can be better, provided the system builder recognizes the limitations of bigger and is able to measure *how much better.*

*DB's OF GAIN*

An antenna (any antenna) has but a hand-



ful of requirements. Primarily, it is installed to receive signal. When one specific signal is desired, it is designed to receive just that one signal and reject all others, and the antenna is designed to transfer as much of the energy which it receives to the down or feedline as possible.

Gain, of all factors, is the most important when you are some distance from the transmitting station(s). It is common to refer to an antenna as having so many DB of gain. Most CATV types reference gain of an antenna as a comparison to the gain of a tuned dipole antenna on the same frequency. Which is to say, if an antenna has 12 db of forward gain, it has 12 db *more gain* than a dipole antenna, when both are mounted in the same location and compared directly one against the other. There are a few antenna types which reference antenna gain to something called an *isotropic source*. Now a dipole antenna is something we can touch, feel and play with. On the other hand, an isotropic source is a mathematically perfect reference antenna that *radiates equally well* (or poorly) in all planes and in all directions simultaneously. It is a handy tool for the antenna designer when he is *building his model on paper*, but it is not something which the average CATV type can associate with, because he cannot hold it in his hand. Because an isotropic source is a paper antenna, even mathematically it has *less gain* than a tuned reference dipole. How much less gain is something of a mystery that requires more explanation than we are prepared to devote here. Suffice to say that normally if you see an antenna that has gain referenced to an isotropic source, the amount of real gain (i.e. as referenced to a tuned dipole) will be in the neighborhood of 2.5 db less than the isotropic source referenced gain.

In designing an antenna system, gain is a function of directivity of the array. That is, a dipole antenna radiates well in two directions (see Diagram 1), both of which are at right

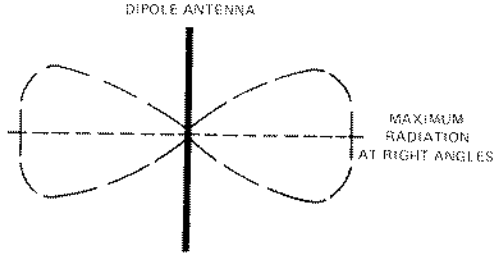



DIAGRAM ONE

angles to its length. If you place another antenna element adjacent and parallel to the dipole element, without regard to what might occur with the dipole feed impedance, the new element can be either a director (i.e. one that *directs the flow of energy* to the dipole) or a reflector (i.e. one that *reflects the flow of energy*). See Diagram 2.

By placing a reflector adjacent and parallel to the dipole the antenna is converted from a bi-directional array to a uni-directional array. That is, the reflector element, because it is physically longer than the dipole element, acts first as a *shield* to block the entry to the dipole of any signals that come towards the antenna through the reflector *field*, and then, as a reinforcing element for the dipole for any signals that travel into the dipole field and pass on to the reflector.

Thus gain is achieved in a *dipole plus reflector* by the directionalizing of the dipole alone, in favor of the direction the antenna points where the dipole is head-on to the incoming signal.

Carrying this technology one step further, if the dipole plus reflector antenna is *enlarged to add a third element*, in front of the dipole (see Diagram 3), the antenna pattern is further enhanced in the forward direction.

Note that the third element, the director, is shorter physically than the driven element, while the reflector was longer physically. The reflector was purposefully longer so as to

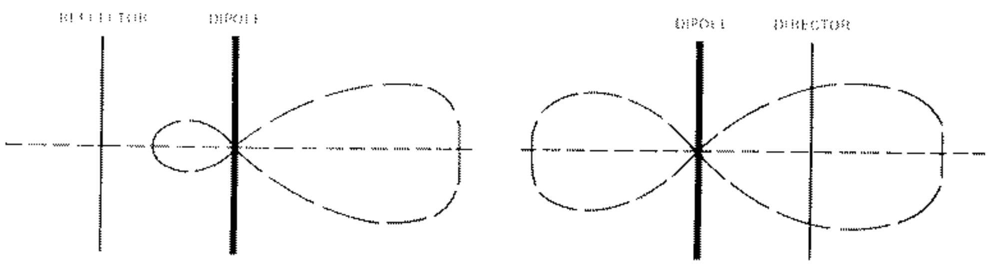



DIAGRAM TWO

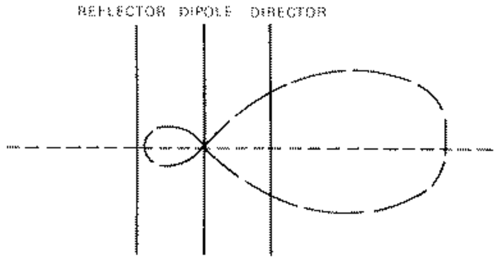



DIAGRAM THREE

block the entry of signals from the rear, to the dipole, and to act as reinforcement to the dipole for signals entering the antenna field from the front (favored) direction. The shorter-than-dipole director performs as a traffic coordinator, and since it is not as long as the dipole element, signals passing through its field are *directed* to the dipole. This sharpens the forward pattern of the antenna (Diagram 3), and the sharper forward beamwidth is where the additional gain is derived.

In any multiple element antenna where antenna elements are placed in line (i.e. a horizontal plane) to assist the basic dipole element, all elements with the exception of the dipole element are considered *passive*. That is, their contribution to the final voltage (i.e. signal voltage) developed across the dipole antenna terminals is entirely related to the effects of these additional *parasitic* (i.e. passive) elements on the overall field of the antenna. Whereas the basic dipole receiving element has a bi-directional pattern (see Diagram 1), the gain of a multiple element antenna (whether log or yagi) over a reference dipole is basically a function of converting the basic bi-directional dipole pattern into a uni-directional pattern with a (very) sharp forward beamwidth. In actuality, the gain of the dipole is not multiplied or enlarged. It is merely concentrated by the parasitic elements into a narrow beamwidth. It is this concentration of beamwidth (or focusing effect) that accounts for all performance of *any* type of high gain antenna array.

Those who find it useful to compute projected signal levels have the able assistance of various mathematical equations and tables to arrive at an expected signal level for any radio (television) signal path. The computation is fairly straight forward, and although it will not be discussed here in this report, it works something like this:

(1) Take the known power output (in ERP) for the transmitter

(2) Add a height-gain factor for height of transmitting antenna above average terrain

(3) Add the receiving system gain (including antenna gain, height gain, pre-amplifier and processor gain)

(4) Subtract path loss (loss per mile for terrain, signal spread), receiver system downline losses, noise figure, etc.

All of this boils down to a set of computations, and in the end you can paper-forecast whether you will have a useable signal plus noise to noise ratio for the system. If you have 30 db signal to noise, and the signal is one that is very desirable, you can probably sell it on your system. If you are a few DB shy of the 30 db minimum requirements, you can look at ways to improve the system efficiency. The transmitter power output and height gain is fixed. So is the path loss. But things like receiving antenna system gain, height gain, pre-amplifier/processor gain, and system noise figure are not fixed. In fact, they are things you can improve (always) if you can stand the cost(s) of the improvements.

From this point on, let us assume a few basic things:

(1) If you seriously consider building a parabolic antenna, you are looking for as much signal enhancement (i.e. *antenna gain*) as you can get. This is to say you have already done, or will do, everything in your power to have the best low noise, high gain pre-amp, the best system active signal to noise ratio (i.e. low noise signal processor and/or converter if required) and when you consider the parabolic, it is because you want those last few DB's of gain you can manage.

(2) You may or may not be cost conscious. However, we must assume that before you go into a parabolic antenna project, you have weighed the total costs of the project versus the benefits to be derived if you can bring in that desired signal.

(3) Finally, the desired signal is gosh-awful weak and any other form of antenna gain enhancement has been considered and tossed out because:

(A) The yagi or log array size required is too big to support on your tower, and/or ....

(B) Too expensive to procure, and/or ....

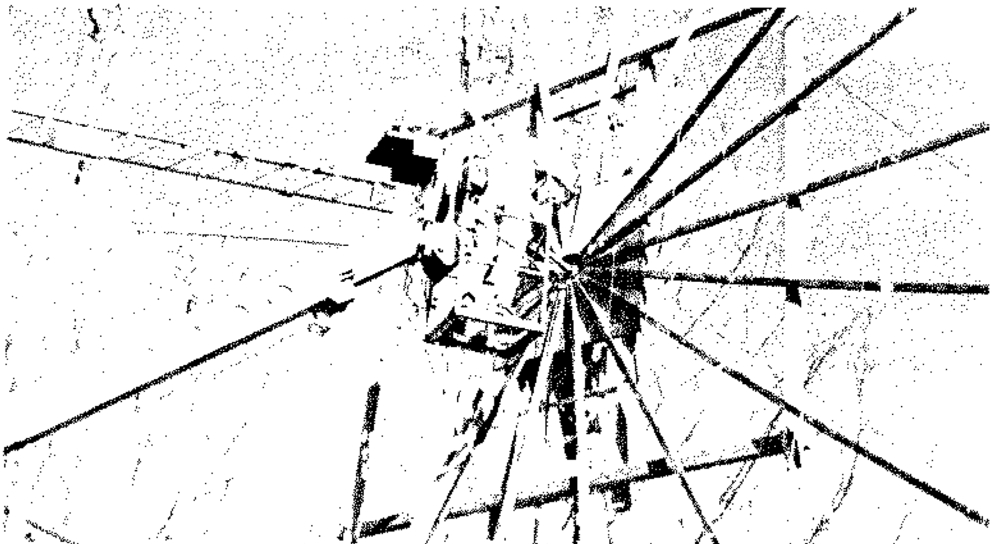
(C) The co-channel problems become too monstrous when 8,16,32, etc. yagis or logs are stacked due to minor lobe patterns in the large multiple antenna array.

However, let's take a quick look at antenna

# LAST ( free sample ) CATJ

This is the third issue of CATJ. During the introduction period for CATJ, more than 20,000 copies of this magazine have been circulated to CATV systems; technicians, broadcast engineers and others with a vital interest in the CATV industry. Effective with the very next issue (August), free sample copies will cease. We know many of you have put off subscribing until now. To receive a copy of the next issue, you must subscribe today. A subscription order form is found on the opposite side of this card.

[Handy July 1974 CATJ Order Card]



# HANDY JULY 1974 CATJ

# ☆ ☆ ☆ ORDER CARD ☆ ☆ ☆

This month CATJ is providing the order card found below for not only subscribing to CATJ (whether as a technician or as a system), ordering the CATJ Super Wall Chart, but also for ordering one or more of the kits described in this special issue. Simply check off the applicable square below, complete your name, address and so on at the bottom, and together with your check, send to CATJ at the address shown on the bottom of this card.

## ★ ★ COMPLETE AS APPLICABLE ★ ★

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☐ — **SYSTEM SUBSCRIPTION** . . . please enter our subscription to CATJ for one year starting with the August 1974 issue. Our check for $10.00 is enclosed.

☐ — **CATJ WALL CHART ORDER** . . . (see Page 41). Please send immediately . . . one wall chart ($5.00) . . . two wall charts ($9.00) . . . three wall charts ($12.00) to the address below. Payment enclosed.

☐ — **MARK-A-CHANNEL Complete Parts Kit** . . . with all parts, ready for assembly as described in CATJ this month. Payment for $175.00 enclosed.

☐ — **MARK-A-CHANNEL** Wired & Tested . . . as described in this month's CATJ. Check for $300.00 enclosed.

☐ — **MARK-A-CHANNEL Kit 2B,** circuit boards . . . circuit boards silk screened, drilled and ready for parts mounting, as described in CATJ this month. Payment for $25.00 enclosed.

☐ — **24 FOOT PARABOLIC KIT 24M** . . . complete kit of all parts, less materials for feed dipole and reflector and .045 lashing wire, as described in this issue of CATJ. Payment of $465.00 enclosed. Shipment FOB Oklahoma City, Ok.

☐ — **24 FOOT PARABOLIC KIT 24M/T** . . . complete kit of all parts, with metal work completed (ready for assembly), but less .045 lashing wire and dipole, reflector elements for feed antenna. Payment of $929.00 enclosed. Shipment FOB Oklahoma City, Ok.

☐ — **24 FOOT PARABOLIC KIT 24F/T** . . . feed antenna for a single VHF (or UHF) channel for 24 foot parabolic. Channel desired is ........ Price is $145.00 when ordered with kit 24M/T or 24M, or $185.00 when ordered separately. Payment enclosed. Shipment FOB Oklahoma City, Ok.

**TERMS**: All materials, kits, etc. offered on this card are backed by CATJ. Enclose full payment with order. Allow 10 days for receipt of CATJ Wall Chart, 3 - 5 weeks for Mark-A-Channel and 3 - 4 weeks for 24 Foot Parabolic.

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gain enhancement with stacked yagi or log arrays, before we seriously consider the parabolic type of antenna.

Table 1 illustrates. As an example, if the antenna you have chosen has 9 db of gain over a dipole (reference), and your system requires 19 db of forward gain, the array size would have to be 16 bays of antennas. Even at high band VHF, that is a bunch of antennas to stack on a tower in one antenna array!

*On the other hand, there is virtually no substitute for effective antenna capture area in achieving antenna gain.* Effective antenna capture area is another way of saying the bigger the antenna array (physically), and the greater the area in space which it occupies, the more signal it will intercept.

*And interception of signal microvolts is the name of the game.*

What about height? There is a rumor going about CATV circles that getting an antenna 300/400/500 feet above ground is the key to developing good quality subscriber pictures. Is that true?

*Not always.*

There is no question that in some circumstances getting the antenna high in the air is important. Let's try to enumerate some of the more common circumstances here:

(1) When the antennas must look at or directly over some manmade noise source (high voltage lines, sub-station, highway) raising the antennas *high and clear* may allow the system designer to arrange his antenna vertical lobe so as to phase (or null) out the noise coming from the manmade source.

(2) When the CATV system is located *just beyond* either the visual line-of-sight horizon from the transmitter, or the radio line-of-sight horizon from the transmitter, raising the antenna 100/200/300 feet may well place the antenna array back into "line of sight" and thereby take it out of a lower signal level class.

However, when the transmitting station is so far distant that no reasonable tower height (say up to 600 feet) will put your receiving antenna array back into the radio horizon strata for the transmitted signal, additional antenna height above ground is decidedly a foolish waste of money.

*This is more than conjecture.* A number of years ago the Collins Radio Company (Cedar Rapids, Iowa) and the old National Bureau of Standards (now ESSA) conducted a long term series of tests on various frequencies from low VHF (49 MHz) through mid UHF (870 MHz). These tests involved setting up transmitters, feeding directional antenna arrays and some 100-400 miles away setting up various receiving sites to receive these transmissions.

Long term (nearly one year) recordings of received signal levels were made, over paths that included regions within the Rocky Mountains (i.e. extremely irregular and heavily blocked terrain), and conversely paths that were essentially across open country (i.e. Midwestern plains).

At each receiving site antennas for the various transmission frequencies were installed at various heights above ground. The average signal levels present at the various height antennas were compared constantly to determine what short and long term benefits were possible with additional antenna height, over paths that were always *beyond the radio horizon,* transmitting antenna to receiving

**TABLE ONE**

**To determine how many antennas of known gain over a reference dipole would have to be stacked (i.e. phased together) to achieve various amounts of forward gain, go to your selected yagi/log antenna data sheet and determine the forward gain (referenced to a dipole) for a single stack. Find that number in the top line below. Then read down until you come to the DB gain you require for your system. The number of stacked antennas (i.e. array size) will then be found in the far left hand column.**

| Array Sz. | 7 DBg | 8 DBg | 9DBg | 10 DBg | 11 DBg | 12 DBg | 13 DBg |
|---|---|---|---|---|---|---|---|
| 1 bay | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 2 bay | 9.5 | 10.5 | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 |
| 4 bay | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 8 bay | 14.5 | 15.5 | 16.5 | 17.5 | 18.5 | 19.5 | 20.5 |
| 16 bay | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 32 bay | 19.5 | 20.5 | 21.5 | 22.5 | 23.5 | 24.5 | 25.5 |
| 64 bay | 22 | 23 | 24 | 25 | 26 | 27 | 28 |

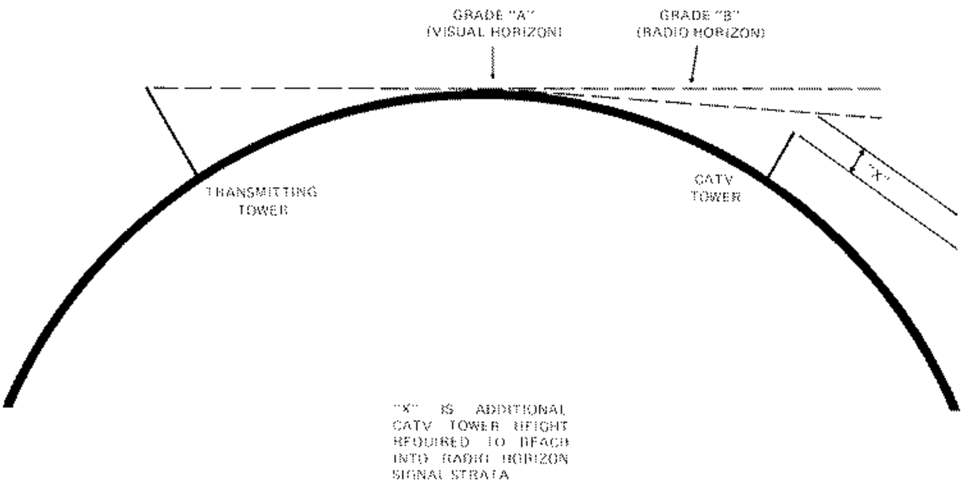



*DIAGRAM FOUR*

antenna. In effect, all of the paths were scatter in nature, the same type of paths which CATV systems encounter when dragging in signals beyond the Grade B contour (i.e. outer limit of Grade B contour is the same as the radio horizon in most situations).

The results were uniformly weighted in favor of antenna height *not being a factor* in received signal levels for scatter type propagation (again, beyond TV Grade B contours). In other words, if you cannot go *up* high enough to move from the scatter level signal strata back into the radio horizon signal strata (Diagram 4), raising the antenna above ground does you virtually no good whatsoever.

In fact, it may hurt you considerably.

The only time it will help is when your antenna must look over or at a *local* manmade noise source. Then it will help *only* if you design your receiving antenna array stacking so that a null is placed by the stacking arrangement towards the local power source.

On the other side of the coin is increased downline losses with increased antenna height (see Table 2), and increased antenna susceptibility to co-channel interference with increased antenna height. Large antenna arrays (i.e. multiple stacks of logs or yagis) always have minor lobe (i.e. receiving pattern) structures which "pop up" as a direct result of the stacking process. A single yagi will have a number of *minor lobes* when used by itself. Two or more yagis stacked together have a combination of minor lobes, the cumulative net of all of the minor lobes of each individual antenna, added to those of every other individual antenna in the stacked array. When these minor lobes add together *out of phase,* they create a *hole* in the receiving antenna pattern and signals approaching the array from a heading that comes through the *pattern hole* are very effectively nulled out (1). On the other hand, when minor lobes are added together *in phase,* signals approaching the array on a line that bisects that enhanced (by stacking) minor lobe are actually enhanced by the big array, perhaps to a much greater degree than on a single stack of the antenna that makes up the big array. The same problem is created with log design antennas, although fortunately for CATV, log antennas are remarkably clean of side and rear lobes, at least when compared with a yagi antenna for the same channel of comparable gain.

So in a nutshell, when you are beyond the radio horizon (typically Grade B contour) height is of no value, provided you are above any in-line local noise sources, and provided the array is high enough above ground to clear any obstacles within a few miles of you. To achieve the kind of DB's of forward gain which you may require for a particular situation, stacking antenna arrays can be dangerous is you have potential side-lobe (i.e. minor lobe) co-channel sources.

This may sound like it is building a case for

(1 - See CATJ, Vol. 1, Number 2, from June, 1974; Page 7)

some dream-antenna-answer. It is a case, but whether the antenna is a dream, or is even an answer for your own situation will be left to you to determine.

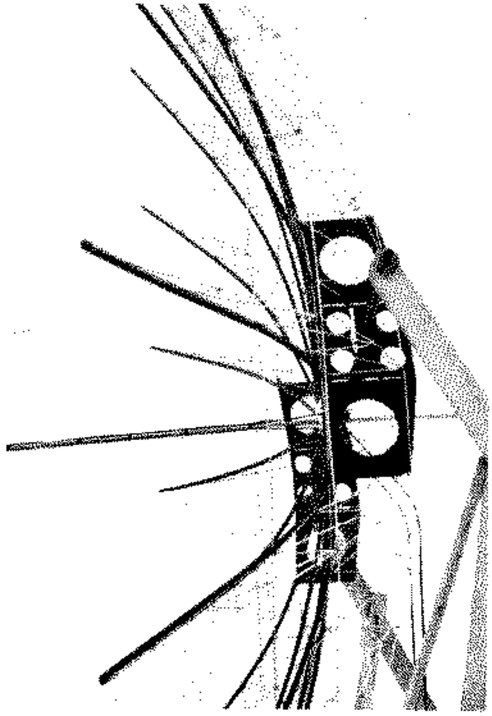
*PARABOLIC CATV HISTORY*

Apparently the first serious use of parabolic antennas for CATV system use at VHF (as opposed to UHF) came about in 1959/1960 when Stan Hosken of North Bay, Ontario, Canada attempted to produce worthwhile VHF signals from Buffalo, New York over a 290 mile path. Hosken's efforts were centered around a 30 foot home constructed dish that was mounted on tracks (see photo) and the mounting system included what is termed an Az-E1 (azimuth/elevation) rotating system that allowed him to rotate the antenna a full 360 degrees as well as tilt it up (above the horizon). Hosken was desperate for TV signals (*any TV signals!*) in those days and he felt that the parabolic offered promise. With Buffalo stations nearly 300 miles away (he got into the dish by steadily building larger and larger yagi antenna arrays, including a 16 bay array of 10 element yagis on channel 4), he often found signals from other distant transmitters more watchable than Buffalo, thus his complex rotating and Az-EL (tilting) system.

Hosken is credited with many CATV antenna feats, including the commercial exploitation of the *Dew Line Parabolic Design* for CATV in the 1963-1966 era, and the eventual formation of Hosken Antennas Ltd., today a producer of several novel CATV antenna lines in Ontario.

During the period 1963-1966, interest in the modified parabolic, or *Dew Line Parabolic*, mushroomed. The Canadians were in the forefront of this antenna research and installation and many Canadian systems today depend upon one or more giant Dew Line type dishes for signals from U. S. transmitters up to 200 miles away. The Canadians are just now getting around to preliminary authorizations of CATV system use of microwave for signal carriage and even today a Canadian CATV system, located at any distance "back" (i.e. North) from the border must rely on whatever signal it can collect directly off the air for cable carriage.

In the 1964-1966 period, dozens if not a hundred or more Dew Line modified parabolics were installed in the United States. Usually the work was done by Canadians, or the systems were engineered by Canadians.



Original Hosken 30' parabolic used 1" mesh and rotated and tracked.

Unfortunately for the Dew Line parabolics, many of them did very badly in the United States, and they consequently developed bad reputations as expensive, throw-away packages that U. S. systems utilized only until the mid 60's freeze on microwave could be circumvented. It is unknown how many of these monsters are still in use in the United States today, but it is probably fewer than a dozen.

In addition to the eventual replacement of these antennas by microwave for most U.S. systems, a very large percentage suffered from extremely sloppy installation. Many were installed (and designed) by people with *tower* experience, apparently on the theory that they were basically a collection of 100 foot or shorter towers bent into an arc and strung with lashing wire for a reflective surface. The theory of operation behind a successful Dew Line modified parabolic is really quite complex, and because of their size, refinements and *fine tuning* (or pruning) are virtually impossible. One installation brought to our attention in researching this article cost the original owner $17,500.00. This 200 foot (by 80 foot high) version was so poorly planned that the focal point of the antenna (i.e. the line of maximum gain and the point where the focused energy concentrated) was nearly 17 degrees off of the proper heading to the 120 mile distant TV stations, and rather than focusing at the proper height above ground called out in the specifications, the array had maximum focusing only a few feet off the ground.

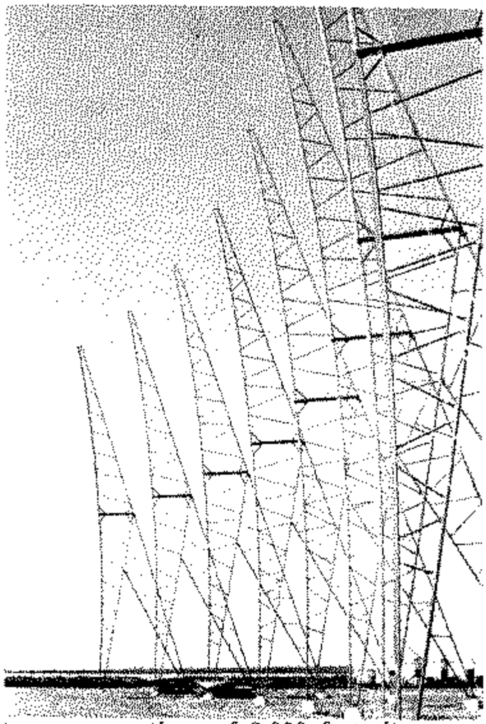
Others (such as one installed on a California mountain) were so poorly constructed that they blew apart in the first strong wind, scattering miles of wire and strand over thousands of yards of countryside.

In spite of these setbacks, and the general feeling in the U. S. that Dew Line parabolics were vastly overrated, the ingenious Canadians still have dozens in service, some of which have been performing for almost ten years.

The crashing and burning of the Dew Lines in the U.S. came shortly after someone figured out that if one was good, two would be better. By separating these 200-500 foot long monsters along a line (or arc) equidistant from the TV transmitter location, two (and in one case, three) of the huge parabolics were space-diversity separated. Initially, installers attempted to add together (i.e. actively combine) the outputs of both antennas into a single downline, just as you might close stack a pair of yagis or logs. But the very long physical separations between antennas (often 2,000 feet or more) resulted in *combining line losses* that far exceeded the most optimistic "stacking gain" for combining two antennas in an active mode.

Left with two expensive antennas installed and no way to combine them actively, another enterprising CATV engineer rediscovered the diversity reception switch first announced by RCA in 1929. This device sensed the signal level present on both antennas constantly, and automatically switched into the "*in use*" mode that antenna which had the highest received signal level at that instant.

Unfortunately it was apparent that nobody involved in these projects had read the mountain of literature available on the subject of diversity reception techniques nor knew that for diversity reception to be *even 10% effective* the physical separation between antennas had to be on the order of 1,000 wavelengths (16,941 feet at channel 2, 3.20 miles!). With maximum antenna to antenna separations of 2,000 feet, it was no wonder that the fellow who put out good money for two Dew Line Parabolics on the theory that he was getting diversity actually ended up with *one and a spare* for his money!



So the Dew Line craze in the States went the way of the hula-hoop and skate board of the same era.

During the latter half of the 1960's, starting around 1966, another CATV type dug up the original Hosken work out in California and set about to determine just how small a parabolic (of the true parabolic design, not the Dew Line type) could be, and still be effective. His problems were a combination of weak signals and co-channel, coupled with no way to go as high as he calculated he needed to be to get clear horizon shots at the 100 mile plus distant signals.

His report, published in *Broadcast Engineering* magazine concluded that a true parabolic exhibited focusing effects and useful gain down to a point where the width of the aperture (the mouth of the screen reflector) was only 3.0 wavelengths across (2). That article included rough construction plans for building 20 and 40 foot models which it claimed offered excellent gain for very few

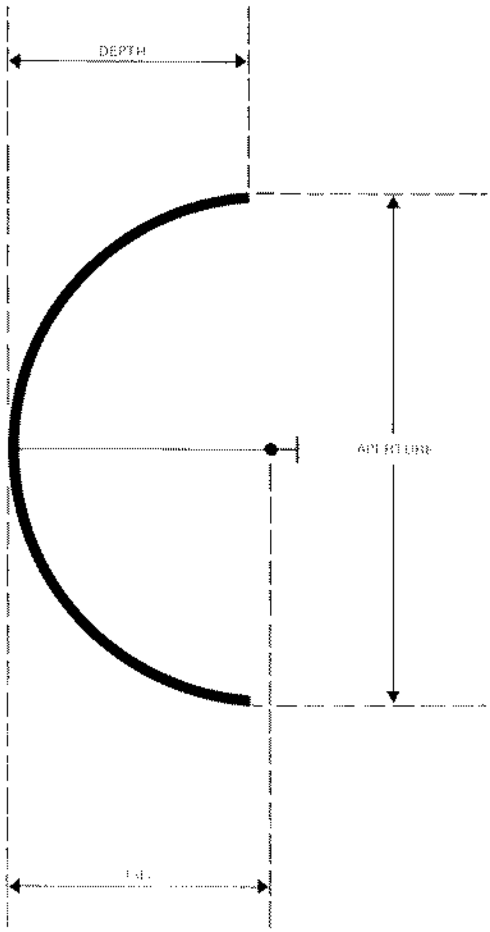



DIAGRAM FIVE

dollars. One of those designs, a 20 footer constructed from redwood struts, has been duplicated with some updating in construction techniques by CATJ for this report.

Apparently somewhere between 50 and 100 of the "Limited Aperture Parabolics" described in *Broadcast Engineering* were duplicated in the late 1960's by CATV systems throughout the United States and Canada. Pictures of several, most of which continue in service, appear here with this article. Most of these were put together by small system operators with a couple of hundred dollars to risk on what promised to be better pictures for their customers, and those interviewed by CATJ for this report fell into two categories:

(2 - See *Broadcast Engineering,* January 1968, Page 14; "A Limited Aperture CATV Antenna".)

(1) *It worked great while it was up, but we put it together too cheaply and it came apart.*

(2) *It works fine, and produces the best signals we have ever had with any antenna array.*

CATJ was encouraged enough by these reports to want to bring the entire subject up one more time, and that is the intent of this report. We set out to build two separate parabolics using today's construction materials and prices. One was constructed from redwood struts, per the original *Broadcast Engineering* article (although modified for tower mounting and feed mounting), and the second was constructed from aluminum channel and flat strap. We will go through the construction of these antennas shortly and discuss their design shortcomings and advantages one by one. First however, let's look at some parabolic design theory.

**THE TRUE PARABOLIC**

The cross section of a true parabolic antenna (or parabola) is *not* part of the circle. The parabola follows the equation $Y2 = 4KX$ while the circle follows the equation $X2+Y2 = K2$ The difference between a circle and a parabola is slight for small parabolas with long focal lengths.

The focal length of a parabola is a fixed length for any given dish, and is independent of frequency. Thus the point where energy is focused in front of a dish (commonly called the focal point) is the same regardless of the frequency on which the antenna is being utilized. This compounds the feed antenna problem as we shall discuss.

If a dish is a true parabola, the focal length can be computed by measuring the diameter of the dish (aperture opening width) and the depth of the dish (see Diagram 5) and then plugging those measurements into the following equation:

$$F = \frac{\text{diameter squared}}{\text{4 times depth}}$$

Normally one does not need to compute the focal length after the fact; it is done as a part of the initial design work. However, there are from time to time on the surplus (military) electronics market some quite large parabolic antennas available which can be purchased for a few cents on the dollar of the original cost to Uncle Sam. Often these rare finds are without feed antennas, or known focusing data, and it becomes necessary to compute the focal point.

The extent to which a parabola in actual design and construction varies from a true parabolic curve determines to a large measure the maximum useful frequency of any given antenna. Another factor that contributes to the maximum useful frequency of any given antenna is the size of the opening (physical) in the screening material utilized to form the reflective surface. Most CATV parabolic antennas are constructed with some form of wire netting, and hard solid reflector surfaces are virtually unknown in CATV.

Suffice to say that in CATV a wire netting with 1 inch openings is adequate for any VHF use and in fact many of the Dew Line parabolic antennas performed very well with 2 inch and 4 inch center to center spacing on the horizontal wires which made up the reflective surfaces.

At UHF, a 1/2 inch wire netting or mesh is adequate up through the upper UHF channels.

The key is to maintain no openings in the netting or reflective surface which approach 1/16th of a wavelength at the upper most receiving frequency. At channel 6 this is 8 inches, at channel 13 this is 3.25 inches, at channel 14 this is 1.45 inches, and at channel 83 this is 0.80 inches. Thus the selection of netting for the reflective surface depends a great deal on the highest frequency for which the antenna will be used. Commonly available inexpensive reflective materials, such as *1 inch chicken wire mesh* or *1/2 inch rabbit screen* must be viewed as attractive screening materials provided their own plane strength (when stretched tightly) is sufficent to keep them taut within the same 1/16th wavelength variations (Diagram 6). Not only must the screen opening(s) not exceed 1/16th of a wavelength for proper reflective qualities (i.e. efficency), but the accuracy of the dish curve (i.e. the ability of the screen netting to "track" the desired curve without *bubbles*) must also be within 1/16th wavelength, or the efficiency of the parabolic antenna will be graded.

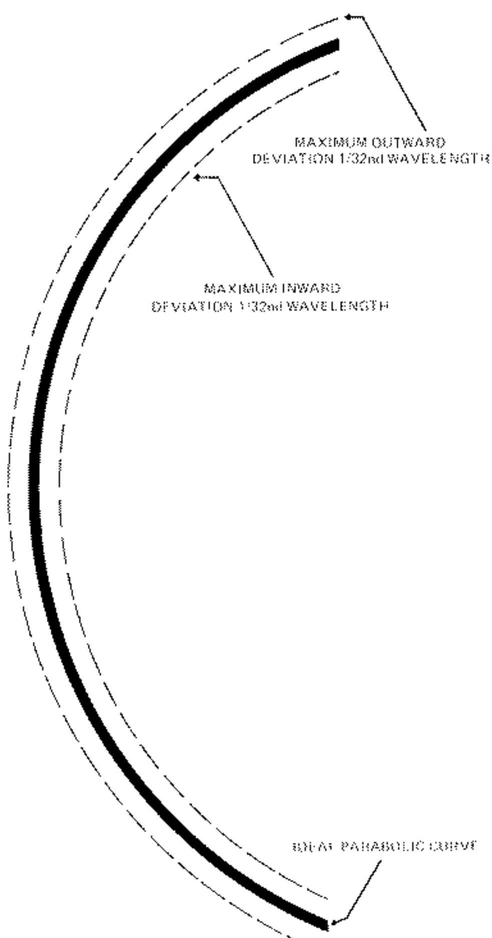



DIAGRAM SIX

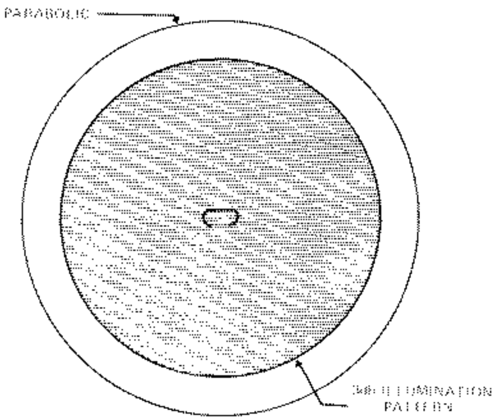
Iron or steel mesh is just as acceptable for CATV purposes as shiney aluminum or copper screen materials, and considerably less money. Many newcomers to parabolic antennas find it difficult to understand that a few strands of wire (with holes *no larger* than 1/16th of a wavelength) can be as efficient a reflection medium as a solid steel, aluminum, etc. surface. But the facts are that a mesh is every bit as adequate and the difference in reflective qualities are so insignificant (approximately 5%) as to be difficult to measure in additional system performance.

The gain of a parabolic antenna system can be fairly closely determined from the following equation:

$$\text{Gain} = 10 \log K \left(\frac{nd}{X}\right) 2$$

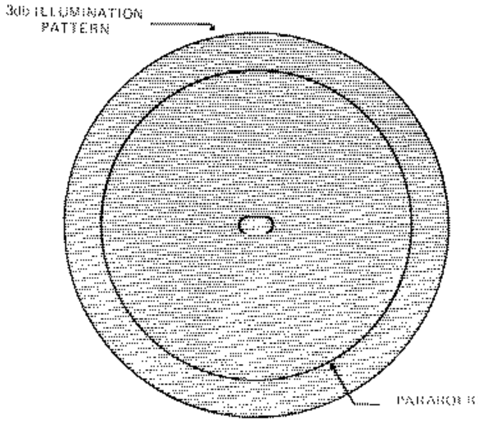
In this equation, gain is in DB over an isotropic source and d is the diameter of the parabolic. The K factor varies from 0.5 to 0.65, but the exact value effects the end result only slightly.

The choice of a feed antenna is perhaps one of the most important considerations, since it is the intent with any parabolic antenna system to *illuminate* the parabola with the feed antenna. If the 3 db beamwidth pattern of




UNDER ILLUMINATED PARABOLIC
WITH TOO TIGHT 3db FEED BEAMWIDTH

DIAGRAM SEVEN




OVER ILLUMINATED PARABOLIC
WITH TOO BROAD 3db FEED BEAMWIDTH

DIAGRAM EIGHT

the feed antenna is too broad, much of the effective capture area of the feed antenna is wasted by "spillage" over the edges of the dish antenna. On the other hand, if the 3 db beamwidth pattern of the feed antenna is too tight, relative to the size of the parabola to be illuminated by the feed antenna, some portion of the reflective surface on the dish is lost to the feed antenna because the feed antenna pattern becomes too sharp to "see" all of the parabola surface within the 3 db beamwidth of the feed antenna. See Diagrams 7 and 8.

There is a relationship in a parabolic antenna between the diameter of the aperture, the focal length of the antenna, and the 3 db beamwidth pattern of the feed or focal point antenna. The relationship is a complex one however, and it is the chief component of the determination of the factor K in the gain equation previously given.

It is possible to work within the framework of the equation on more practical terms by simply describing the focal length and aperture (width) as a simple ratio (called the f/d or f to d ratio). This is the focal length to diamenter (aperture) ratio. In many military parabolic antennas, this is generally in the 0.3 area (i.e. a 10 foot dish has a 3 foot 4 inch focal length).

Previous articles have talked about a 0.5 f/d ratio (2). Serious designers of parabolas maintain this is an end result, of a complex set of equations, and not a handy design tool as some maintain.

Basically, the serious designer starts out with a feed antenna which has the type of 3 db beamwidth he requires to maintain absolute control on side lobe radiation from the feed antenna itself. If, for example, the 3 db beamwidth of a certain feed antenna is 40 degrees, he places the feed antenna down on paper and then computes the dish he requires to illuminate exactly the whole reflective surface within the 3 db beamwidth. This generally works out close to an f/d of 0.5 however.

The basic premise with any parabolic antenna is expressed in very simple (if not entirely accurate) terms:

*The screen reflector of the antenna is so shaped that any signal approaching the screen reflector from the front is reflected from the reflective surface to some (out in front) focus point. Signal energy intercepted by the screen reflector, because of the curved parabolic shape of the reflective surface, travels an equidistance from the reflective surface to the focus point. A feed antenna, located at the focus point of the antenna, intercepts the in phase energy reflected to that point by the reflective surface. The forward gain of the parabolic antenna is a function of its capture area, which in turn is expressed in square feet (or square wavelengths) of surface area, less any inefficiencies in the system.*

Generally, if a parabolic antenna system is 50% efficient (i.e. 50% of the intercepted wave energy appears at the antenna terminals of the feed antenna), the antenna is doing just about all that can be reasonably expected of it.

**f/d VS. FEED BEAMWIDTH**

**How do you arrive at the feed antenna beamwidth for various f/d ratios? Lamont Blake in his fine *Antennas* book (John Wiley & Sons, publishers] sets forth the following table:**

| f/d (*) | Feed Beamwidth |
|---|---|
| .10 | 273 degrees |
| .25 | 180 degrees |
| .50 | 106 degrees |
| 1.00 | 56 degrees |

*** — as a function of aperture; .10 is 10 percent (1/10th) of the antenna aperture.**

| f/d VS · Dish Size | Aperture Focal Length (0.5 f/d) |
|---|---|
| 8 feet | 4 feet |
| 10 feet | 5 feet |
| 12 feet | 6 feet |
| 16 feet | 8 feet |
| 20 feet | 10 feet |
| 24 feet | 12 feet |
| 30 feet | 15 feet |
| 36 feet | 18 feet |
| 40 feet | 20 feet |

**The aluminum strut version described here has been calculated for an f/d of 0.47, a minor difference perhaps from 0.5 f/d, but one worth noting. At 0.5 f/d, the main concern tends to be for side lobe control of the radiation pattern while at 0.47 f/d the dish is "tuned" for maximum forward gain. The gain loss between 0.5 f/d and 0.47 f/d is 1.0 db or less, with 0.47 f/d being the better gain of the two.**

## CHOOSING A FEED ANTENNA

The feed (or focal point) antenna choice is one of the most important considerations to be worked out. If the antenna builder selects a 40 foot dish size as the largest he can handle (and here we assume the typical builder will think less about how many DB of gain he must have and more about how many square feet of antenna loading he can build and keep up in the air!), and he follows the table here to arrive at a f/d of 0.5, he has already determined that his focal point antenna will rest 20 feet (0.5 x 40 feet) in front of the center of his reflective surface.

However, how do you select a feed antenna that will see all of that 40 foot of reflective surface (at a distance of 20 feet), within the 3 db beamwidth of the feed antenna? Obviously, you have to know something about the characteristics of the feed antenna.

It may be difficult to envision, but a high gain feed antenna (i.e. a 5 element yagi) is a very poor choice. There is only so much reflected energy coming off of the reflective surface of the parabola, and at a distance of 20 feet (reflective surface to feed antenna dipole) the gain of the feed antenna (relative to a dipole) is inconsequential. There is simply not very much propagation loss in 20 feet of free space!

On othe other hand, as has been set forth already, the pattern or beamwidth of the focus antenna is everything. A five element yagi, with a 38 degree 3 db beamwidth just is not going to "see" all of that big 40 foot aperture it is looking at only 20 feet in front.

Honestly, the best feed antenna is a dipole with a reflector. In some *rare* situations, you *might* add one (single) director element to the dipole plus reflector, but, in the process, you are likely to sharpen the feed antenna beamwidth to the point where the feed antenna is only looking at a small portion of the reflective surface within the 3 db beamwidth of the feed antenna.

Improper selection of the feed antenna is probably the most common mistake with first time parabola builders. Those who built the *Limited Aperture Parabolics* described initially in *Broadcast Engineering* (2) in particular seemed to have this problem. Many duplicators of this antenna utilized whatever feed antenna they had laying about, including some who stuck in ten element yagis!

Recall if you will that the focal point (i.e. where the feed antenna must be located) is the same (location) for any frequency on which the parabolic will be utilized. This presents the only *real problem* in the selection of a feed antenna.

If the focal point is at point "X", it is not possible to locate more than a single feed antenna at that point (recalling that no more than one object can occupy the same space at one time!). So something has to give.

You could select a log feed antenna, but it gains its wide frequency range coverage through staggered active elements. If a log covers channels 7-13, for example, the frontmost active elements function (as the shortest elements on the antenna) at the top end of the frequency range while the back-most ac-

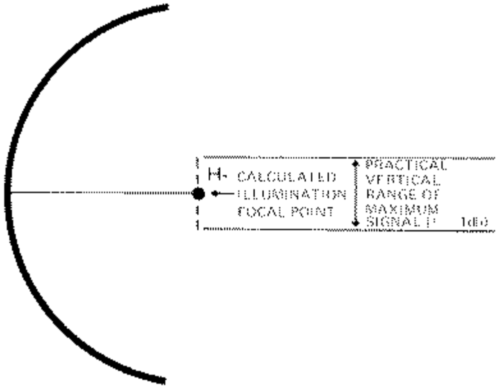



*DIAGRAM NINE*

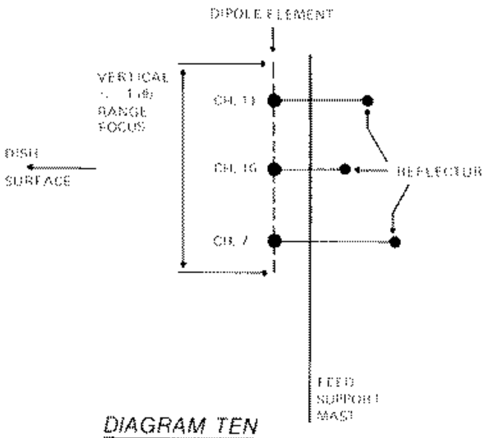
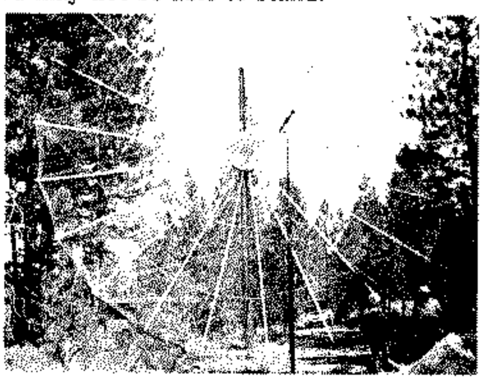



*DIAGRAM TEN*

tive elements function (as the longest elements on the antenna) on the low end of the frequency range. Since the focal point is indeed a *point*, obviously not all of the required active elements on the log can be at that point at the same time.

Now if you are going to use your parabolic antenna on a single channel, you have no problem. The dipole feed is simply selected for the one channel of interest.

Complicating the problem for the multichannel user is another factor. If you select a short-log for the feed (i.e. one with a compressed boom length and a front 3 db beamwidth which is appropriate to illuminate the dish size chosen) and wish two or more channels from the feed, you are going to have to run the output of the feed antenna through a two (three, four, etc.) way splitter to divide the output of the feed into the appropriate number of downlines to drive what we assume will be low noise single channel pre-amplifiers, and this, of course, is split loss which you may not be able to stand.



40' redwood parabolic in Oregon is pole mounted. Feed antenna is too narrow.

Let's look at the problem with less theory and more practice. In theory, while the focal point is at a single location, experience with several dish antennas has shown that it tends to be adequately broad in the vertical plane (Diagram 9) to allow you to mount two or three separate feed antennas. If you are going to use two or more separate feeds, with independent feedlines for each, you should consider not using a solid or screen "splash plate" for both antennas, but rather single passive reflector elements behind the dipole elements. If you were to mount a mesh (or solid splash plate/reflector behind two or more dipole elements), the area encompassed in front of the parabolic screen would begin to become considerable, and would in effect block the passage or view of the center of the dish to the direct *inward bound* signals to the reflector surface.

As Diagram 9 shows, experience (vs. theory) indicates that the actual illuminated area in a 20 (and 40) foot parabolic dish antenna is relatively speaking wide in the vertical (up and down) plane. The point at which the feed antenna dipole intercepts maximum signal is rather peaked along the horizontal plane ("H" in Diagram 9) but within +/-1.0 db range, it tends to be up to 2 feet tall on a vertical scale on a 20 footer and up to 3.5 feet tall on a 40 footer. This then suggests a method of supporting two (or three) separate feed antennas, all within the illuminated region shown in Diagram 9. See Diagram 10.

With the feed antenna selection, and multiple-channel feed problems dismissed, we can get on with the dish itself.

**HOW TO SUPPORT?**

There are at least two schools of thought relating to *hanging the dish*. One is that you

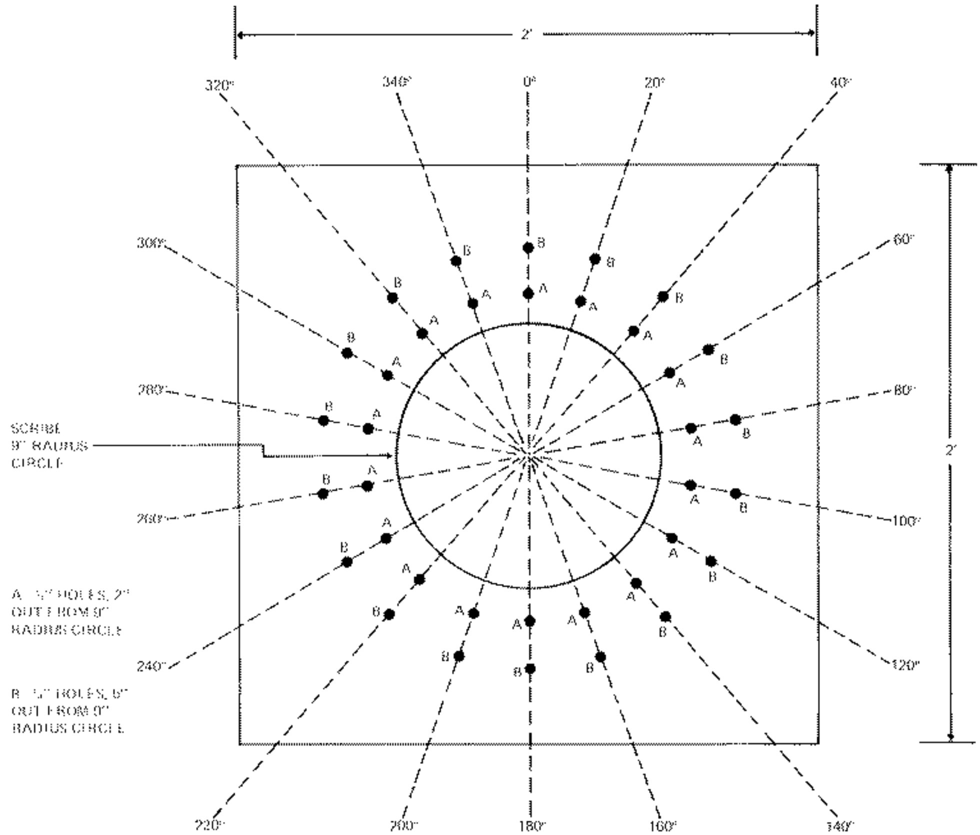
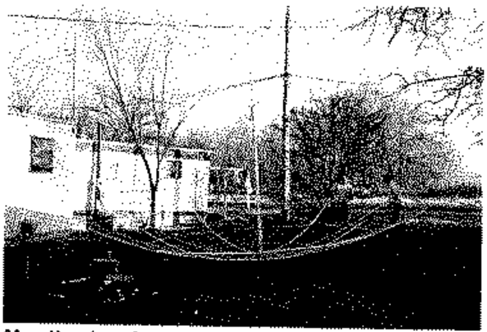



DIAGRAM ELEVEN

place it close to the ground, on its own supporting structure, and locate the feed out in front of it on its own support structure. This approach was followed by many who duplicated the *Limited Aperture Parabolic* (2). The second approach says you figure out a way to support the feed from the super structure of the dish itself, on some type of mast arrangement that is tied at one end to the center of the dish structure.

The first approach is by far the simplest, and it offers the builder an opportunity to *experiment* with different feeds and things like accurately determining the focal length (focus point). If you build the antenna *exactly* as shown, you will have an f/d of 0.5. That means a 20 foot antenna will focus 10 feet in front of itself, 10 feet up from the base of the lower front edge of the screen. The focus is in effect centered with the dish center, 10 feet out. If you mount the antenna just off of the ground (which is entirely adequate if noise is no problem and you have no terrain obstructions or heavy vegetation within several miles), the feed antenna can be mounted on a moveable tripod such as one of the inexpensive Rohn rooftop home antenna (three legged) mounts. In this way you can change the feed antenna with ease, move the tripod in and out to ascertain the accuracy of your focal point, and generally get better learning-use out of the antenna.

*It may be that you will want to construct a 20 foot parabolic following the redwood strut construction outline here as a start, to get your feet wet. Remember a number of these have been in service (up to 40 feet in aperture) for 5-8 years; properly constructed and mounted they will last some time. If you find the 20 footer effective, you might then graduate to one of the aluminum strut versions also described here, with a center mounted feed.*



24' all aluminum super structure parabolic with center mounted feed.

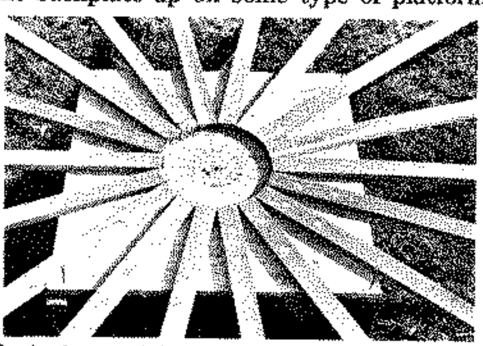
**REDWOOD STRUT VERSION**

A list of required materials for the redwood strut version appears here. Total cost in most areas should run under $50.00 for the materials.

The first job is to prepare the backplate. See Diagram 11. The backplate is shown for simple direct to tower leg mounting. Note in the accompanying photographs of construction details that by adding a metal plate in front of the wooden plate and a metal frame behind it (Diagram 12) that you also provide a sturdy assembly to mount the dish to, four tie points for back guys for the individual struts, and a handy way to lift the array up into the air after construction with a winch line or rope and pully.

The struts are prepared by drilling them for 1/4 inch eye bolts at the 4, 8 and 11.5 foot levels, plus, drilling for 1/4 inch x 3 inch machine bolts at the 2 inch and 5 inch points (see Diagram 13). Notice that the inner ends of the 12 foot struts rim a 9 inch radius circle butting against the 9 inch radius mark on the backplate. This results in a tight but acceptable fit between the redwood struts.

A flat area is required for assembly. Set the backplate up on some type of platform that will allow you to get underneath of it to tighten the bolts that mount the struts, and proceed to install the 18 struts. Note that they are spaced 20 degrees apart. When the struts are installed with the 1/4 inch by 3 inch machine bolts (note washers go under the head and under the nut), the eye bolts can be installed at the 4, 8 and 11.5 foot levels.



18 struts are laid out per text on plywood backplate.

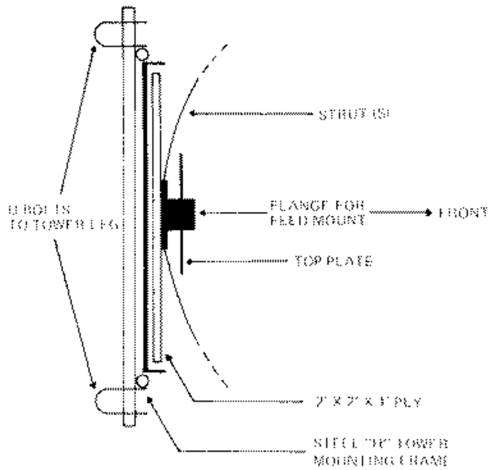



DIAGRAM TWELVE

You have an option here of adding a fourth eyebolt, this one *facing away* from the dish center, at the 10 foot level. If you choose this option, you have a secure point to back guy the struts from, using garden variety hardware store turnbuckles and 7 strand TV guy wire (see Diagram 14). The struts really need some form of back guying, for both strength and as a means of correcting for construction inaccuracies in the pulling-up procedure to be described.

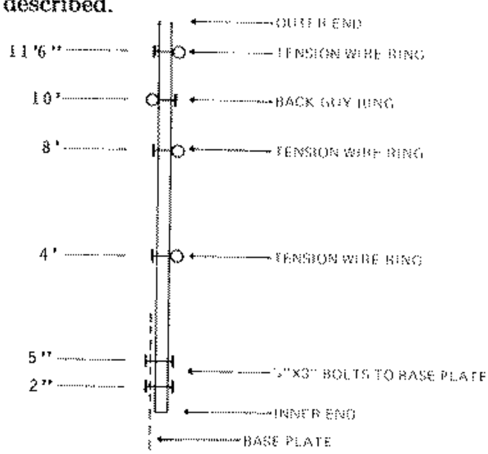



DIAGRAM THIRTEEN

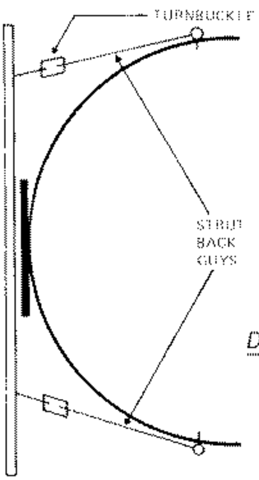



DIAGRAM FOURTEEN

Next 1/8th inch strand guy wire (common garden variety of TV guy wire) is strung through consecutive sets of eye bolts at the 4 foot, 8 foot and 11.5 foot levels. Start the guy wire lacing at one common strut point on all three levels at a point which you have now decided will be the *bottom* of the antenna facing down toward the ground. In effect you are running the light weight guy wire through all of the common 4 foot levels, then another piece through all of the 8 foot eyebolt level, and finally a third piece through all of the 11.5 foot level eyebolts.

Now if you are very clever, and work slowly, you can grab each end of the guy wire, between the two struts where you began lacing and ended lacing on a level, and *pull in* to tighten the circle and by magic the struts will bend inward and begin to take on a parabolic-like shape.

Using a come-along device, start with the 8 foot level guy wire and slowly increase the tension on the guy wire ring. As you tighten

**20' VS. 36' REDWOOD PARABOLICS**

**This table compares various changes to be considered when determining whether to build a 20' or 36' redwood parabolic.**

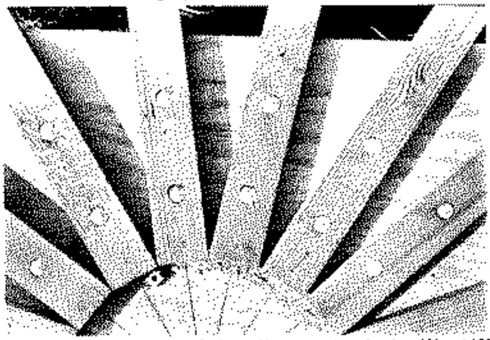
| | 20' | 36' |
|---|---|---|
| Focal Length | 10' | 18' |
| Quantity Struts | 18 | 20 |
| Angle Between Struts | 20° | 18° |
| Tension Ring Levels | 4', 8', 11.5' | 5', 10', 15',19.5' |
| Backplate | 2'x2' 1" ply | 4'x4' 2" ply (2-1") |
| Physical Depth (Diagram 5) | 30" | 48" |
| Tension Cable | 1/8" | 3/16" |

the strand tension, be very careful to stop every so often and walk around the dish moving the struts back into an in-line position. They may tend to slide along the guy wire ring towards you at the come-along as you tighten up the wire, and if they slide more than a couple of inches they will twist and break off.

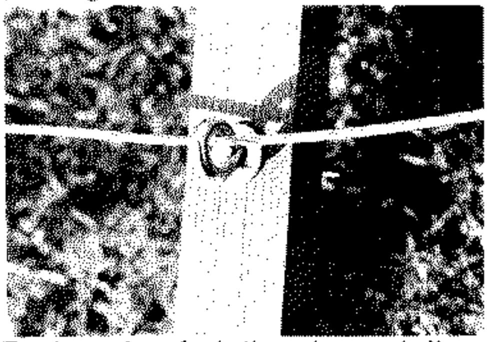
When you have the 8 foot level up to a point where the outer ends of the struts are approximately 26 - 28 inches higher (3) than the backplate, replace the come-along with a fully extended turnbuckle, cinch the guy wires with the turnbuckle but leave the turnbuckle extended for now.

Now repeat the process at the 4 foot level, and then once again at the 11.5 foot level.

In our 20 foot (example) parabolic dish, our f/d of 10 foot relates back to a depth from (3 - Diagram 5 here)



9" circle on backplate allows struts to "butt" end to end.



Tension wires feed through eye bolts on struts to form parabolic curve.

the backplate front to the front edge of the dish of 30 inches. This is an easy measurable target to shoot for as you cinch up on the guy wire rings. The last inch or two can be taken up with the turnbuckles. Tighten up on the 11.5 foot level first to achieve the proper 30 inch depth (Diagram 15) and then tighten up on the 8 foot and 4 foot level rings until they have good tension.

At this point you are ready to lay in the netting for the reflective surface. Your choice of netting will depend on the upper frequency limit of the antenna, as previously discussed. Start by laying in the center piece (Diagram 17), wrapping it around the 11.5 foot tension strand at the top of the dish and laying it flat following the contour of the dish across the center of the opposite (bottom) side.

The netting is attached to the frame as follows:

(1) Bubbles or "dents" are taboo. Remember that any screen reflection surface deviations of 1/16th wavelength or more will cause inefficiencies with the focused signal(s).

(2) The netting needs to follow the contours closely. It is stapled to the wooden struts (don't spare the staples!) wherever it crosses a strut.

(3) Wherever it crosses a tension ring wire, take a short length of lashing wire (1 - 2 inches long) and wrap the netting to the tension ring as shown in the photo here. The more spots where you tie it down to something behind it, the better the chances for maintaining the +/-1/32 wavelength (1/16th wavelength total) tolerances required.

Work it with your hands, smoothing it out carefully as you work it from top to bottom of the dish.

The next section or panel of netting (3 foot wide material is fairly easy to work with) overlaps the first section by 6 inches

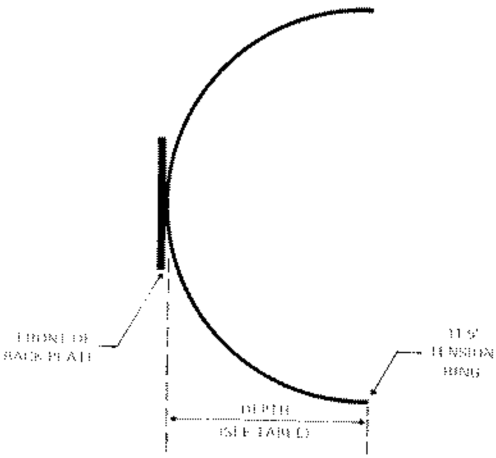
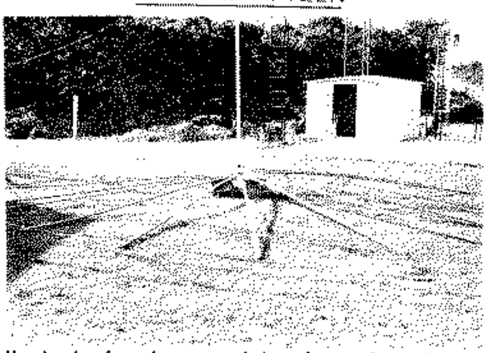
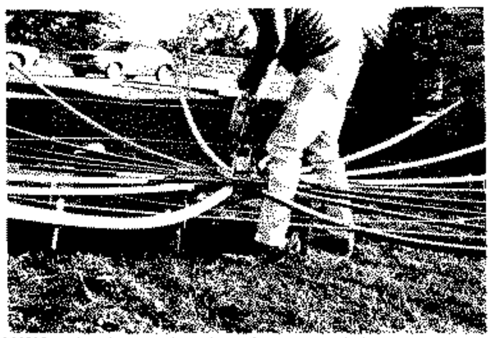



DIAGRAM FIFTEEN



All struts in place, and tension wires strung through eyebolts, ready for "come-along" pull.



With struts under tension, steel front plate is installed over ply backplate (Diagram 12).

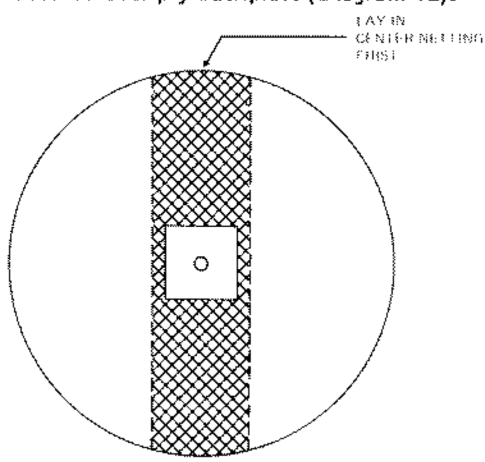



DIAGRAM SEVENTEEN

(Diagram 18). It is secured just like the first, but, additionally, a length of .045 lashing wire is woven in and out of the two layers where they overlap by 6 inches, from top to bottom of the dish. This is a combination of a strength procedure, and it provides some insurance that the reflective surface will not develop additional bubbles where panel sections join. It is also insurance that the whole antenna reflective surface represents the same approximate ground resistance. You can really do it up right by going along and tack-soldering the overlapping pieces a spot at a time every 6 inches or so after the weaving process is completed.

This process is completed until the entire surface area is covered with netting.

At this point re-check the depth of the dish (Diagram 15) for the prescribed (30 inches with a 20 footer) measurements.

If the antenna is to be mounted low to the ground, on a tower or wooden pole, it is ready to be pulled into position, after you do some back guying preparation. Back guying the struts is considered a necessity to prevent the dish from folding in on itself should a strong gusty wind come at the antenna from the rear. If you use a 2 x 4 wooden back frame

**REDWOOD PARABOLIC MATERIALS — 20'**

**Struts — quantity 18, 12' long, 1.25" square redwood**

**Backplate — quantity one, 1" plywood, 24" x 24"**

**Backframe (*) — quantity four 2 x 4's, 10' long**

**Bolts — 1/4" x 3" to mount struts to back frame, quantity 36 plated with 72 1/4" washers and 36 nuts**

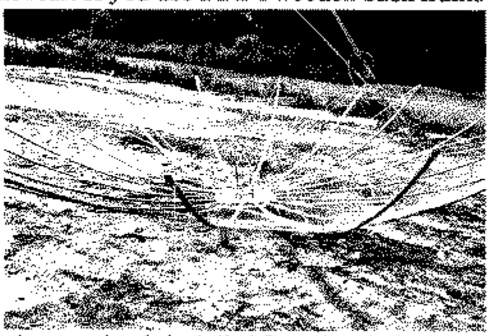
**Eyebolts — quantity 54, 1/4" x 2", with 108 washers and 54 nuts, all plated (add 18 eyebolts, 36 washers, 18 nuts if optional back guying is provided)**

**Screening — 3' width, 1" or 1/2" chicken or rabbit wire; approximately 140' (lineal) required**

**Lashing Wire — Approximately 280 feet required for weaving, tieing, lashing**

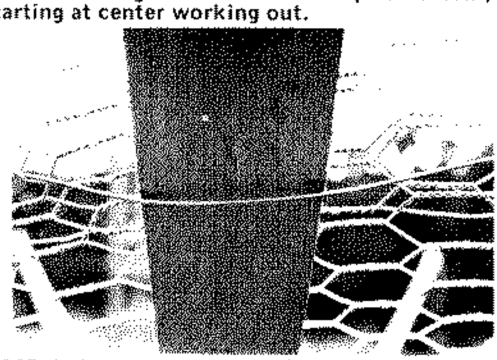
**Feed Antenna — see text**

*** — see text for back frame discussion. For dishes larger than 20', of redwood construction, adjust strut lengths accordingly, as well as other hardware requirements.**

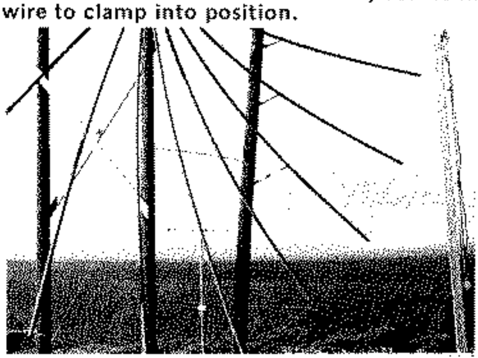


Mesh screening is installed from top to bottom, starting at center working out.

Where screen crosses tension wire, use lashing wire to clamp into position.



.045 lashing wire goes under struts where it crosses struts.



Oregon 40' construction utilizes poles as back supports on struts.

(Diagram 19) or a metal super structure (Diagram 12) you have a built-in back guying anchor system. The back guys can be either light weight (7 strand) TV antenna guy wire, with turnbuckles, or nylon rope with (or without) turnbuckles. The extra set of eye-bolts fed through each strut and facing to the rear at the 10 foot levels provide the anchor points for the back guying attachments on the struts. Every strut needs to be back guyed individually, if you guy any at all, since uneven torque is created under wind stress if you guy say every other strut. This may cause the unguyed struts to flex beyond their breaking points.

By attaching a pully or winch line on the tower, the 20 foot (or larger) dish can be carefully hoisted off of its back (i.e. where it was assembled) into an upright position just a few feet off of the ground at the base. The backplate can then be bolted to the tower leg.

*A Rohn 25G type of tower will adequately support a 20 foot dish in most locales, if the Rohn is kept to 30 feet in height and is installed in a 1-2 yard concrete base. If you have a 20 inch or larger tower face on your existing tower, there should be no problems*

CONTINUED ON PAGE 26

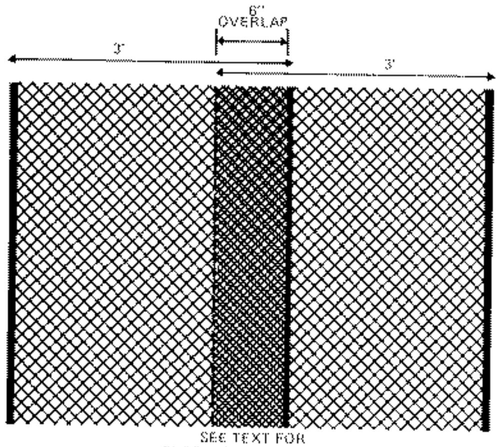


DIAGRAM EIGHTEEN

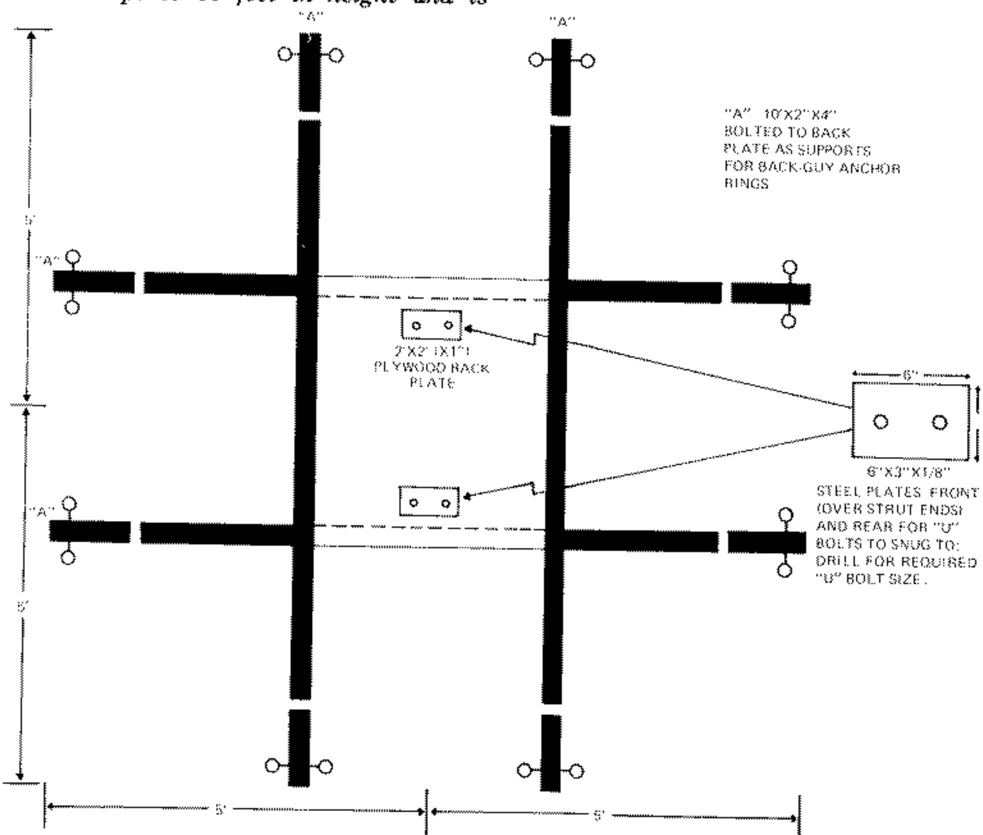


DIAGRAM NINETEEN

## 24 FOOT ALUMINUM STRUT CONSTRUCTION

Construction of the aluminum framed dish is more detailed than the redwood version, and more costly. However, it provides the user with a more durable antenna, and one which is likely to have greater accuracy (+/-1/32nd wavelength) than a redwood version.

The aluminum version shown on these pages was initially constructed as a "backyard project" for experimentation. It has since been refined for rotation and ruggedized to withstand installation at some height above ground.

The list of materials given is for the basic dish, less the mounting frame (required) for tieing the dish to a tower or support structure. The materials are offered in kit form by CATJ with or without all of the metal work completed (channels cut, holes drilled, etc.), ready for assembly in the field. This is available with or without a hub mounting (PVC supported) feed antenna. Without the feed antenna, you can either tripod mount in front of the antenna, or design your own. With the feed, you would hub mount the PVC feed support with the materials supplied. Feeds, when supplied, are for a single channel (specify).

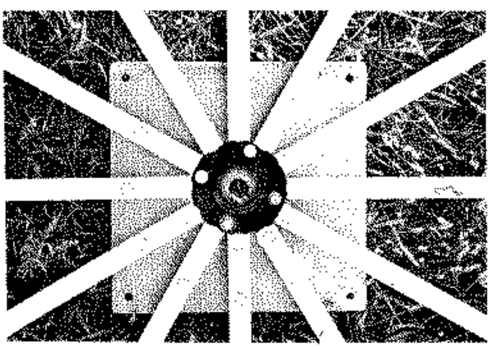
Basically, the 24' aluminum version goes together much in the same manner as a redwood version. Once all holes have been drilled, and all materials prepared for assembly, the aluminum struts (12) are installed on the hub with 3/8" x 2-1/2" bolts (nut and washer) using a 1/2" x 7/8" spacer inside of the channel (see photo) to insure that as you tighten up on the nut the channel-strut does not draw in and collapse. All 12 struts are installed, and made finger tight only. The hub should be sitting on a small platform to allow you to work underneath with the nuts.

Then the 1" x 1/8" aluminum straps, 7' long (total of 11), are bolted into position around the outer rim. As the last of the straps are mounted, you should have two "helpers" who will lift up on the ring of straps at two points as you position the last (11th) into position. This will force the aluminum struts UP and the positioning and tightening of the 11th will cause the struts to bow into a parabolic like shape.

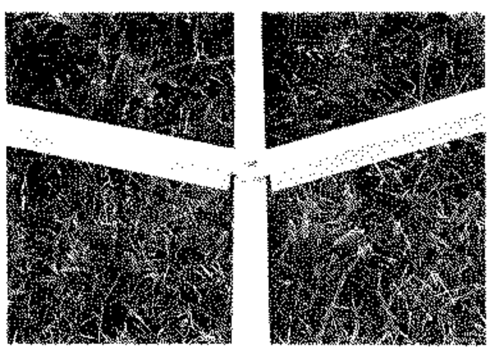
Next the aluminum channel pieces (notched per the photo here) are fitted into place (11 again) in one or the other of the cross support points. In the aluminum parabolic offered in CATJ kit form, there are cross-rib supports at five locations on each strut, not the two shown. Between the five cross-rib supports and the outside strap, the struts are secured every two feet from the hub out.

When you initially placed the outside straps on the ends of the struts, you forced the parabolic form to create itself. However, it is closer to a circle than a parabolic at this point. By cross-rib supporting it every two feet (approximately), you force the struts back into a parabolic shape. They are held in place by 1/4" x 20" x 1" stainless hardware.

When all of the cross-rib supports are in place and the straps are in place, then you go back in under the dish hub and tighten up (with a wrench) the hub mounting bolts.



Aluminum version uses 12 struts.



Strut to strut braces are notched.

## ALUMINUM PARABOLIC MATERIALS — 24'

All of the materials listed here are available in a number of kit forms (see announcement). The materials listed will build a complete 24' aluminum strut parabolic, less the dipole and reflector elements on the feed.

| Quantity | Item |
|---|---|
| 12 | RIBS — 1" x 1" x 1/8" aluminum channel |
| 1 | HUB — 12" x 12" x 1/4" plate |
| 11 | 1" x 1" x 1/8" aluminum channel, 2' long |
| 11 | 1" x 1" x 1/8" aluminum channel, 3' long |
| 11 | 1" x 1" x 1/8" aluminum channel, 4' long |
| 11 | 1" x 1" x 1/8" aluminum channel, 5' long |
| 11 | 1" x 1" x 1/8" aluminum channel, 6' long |
| 11 | 1" x 1/8" aluminum strap, 7' long |
| 700' | 1" poultry/rabbit 15-1/2 gauge wire mesh, or 1/2" hardware cloth |
| 1 | 15' of 1 - 1/2" SKD80 PVC pipe for feed support |
| 1 | 1-1/2" floor flange for feed mount |
| 30 | Nuts, bolts, washers, 3/8" x 2-1/2" |
| 30 | Spacers, 1/2" x 7/8" |
| 72 | Nuts, bolts, washers, 1/4" x 20" x 1" |
| 80' | 3/8" diameter nylon rope |
| 1400' | (.045) lashing wire |

## 24' PARABOLIC KITS

Recognizing that aluminum materials are difficult to procure in many areas, and that some readers may prefer to construct the dish less the drilling, cutting and punching required for pre-assembly work, CATJ has arranged to have the materials made available in a number of ways.

These kits may be ordered directly from CATJ using the tear out card enclosed with this issue. The kit description appears here.

Kit 24M —

Includes all materials listed in the parts list, less the 1400' of .045 lashing wire. No metal work done. Shipped FOB Oklahoma City to your continental USA location. $465.00.

Kit 24M/T —

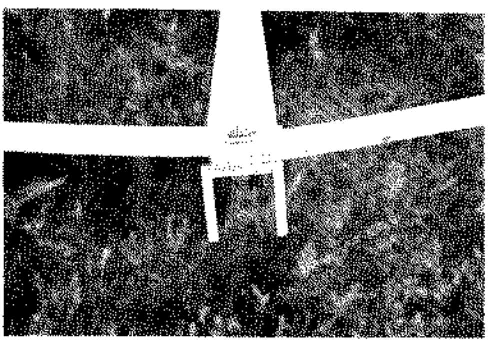
Includes all materials listed in the parts list, less the 1400' of .045 lashing wire. All metal work (cutting, drilling) done, ready for assembly. Shipped FOB Oklahoma City to your continental USA location. $929.00 (with 1" wire).

Kit 24F/T —

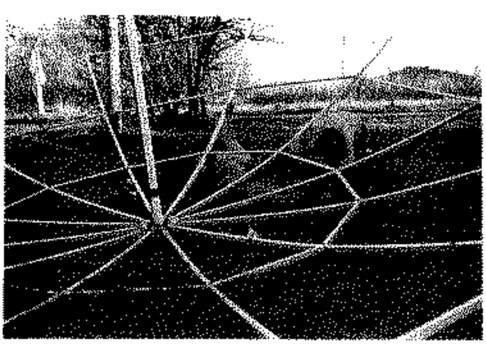
Single channel feed with splash plate reflector, 75 ohms, for High band VHF or UHF channel of your choice, shipped knocked down but ready to assemble and mount on your dish. Specify channel of use.

Kit 24F/T as part of an order for Kit 24M/T, $145.00.

Kit 24F/T as separate item not ordered with Kit 24M/T, $185.00.



Flat end of strut brace to strut mounting.



Screen mesh is anchored to struts and braces.

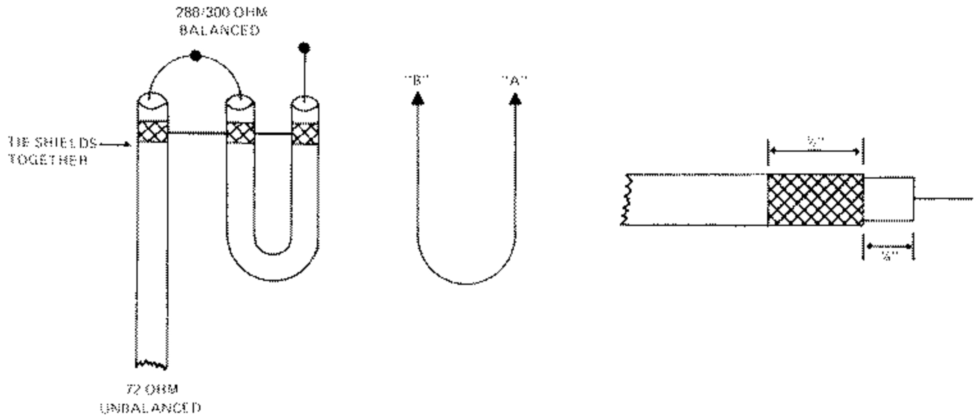



DIAGRAM TWENTY

*with mounting up to a 40 footer on the tower leg (or across the face to two legs if you have the tower pointing in the correct direction!).*

Assuming your feed antenna is separately mounted on its own mount, follow the tuning instructions given separately.

**ALUMINUM STRUT VERSION**

The aluminum strut version follows the same basic procedure, except, of course, you are not going to pull the aluminum struts into the proper shape with tension wires and a come along!

The 24 foot aluminum version shown here was constructed by CATJ using materials selected to allow the builder to duplicate it without special tools. The struts actually will "snap" into the proper form when the aluminum or steel flat stock between struts is bolted into place. The thickness of the aluminum channel utilzied for the struts is important; stock that is too heavy won't bend nearly enough to give you the depth required for an f/d of 0.5.

In the aluminum strut version, the back plate is also aluminum. Additionally, the wire mesh is 1/2 inch "rabbit wire" which has a considerably stronger surface area than the 1 inch "chicken wire". It is best to cut it into panels shaped as per Diagram 20 and to bolt it into place as the photos show.

For sizes above 24 foot, out of aluminum struts, the aluminum channel *must be preformed* into the proper parabola curve (shape) *before* any attempts are made to assemble the antenna. This requires some expertise with metal forming equipment, or a source of the pre-stressed struts (4).

Additional information on assembling the 24 foot aluminum construction model is found separately here.

**MOUNTING THE FEED/TO DISH**

When the feed mounts on the back plate of the dish, some mechanical problems arise. There are any number of *stout* materials around which will self-support a 10 foot section of itself, with only one end attached to a firm point. Many of these materials are metallic, however, and this is to be avoided. Schedule 80 PVC pipe, 2 inches in diameter or larger, is a reasonably good choice in a non-conducting material but it will need some form of *tie-down* as illustrated in Diagram 21.

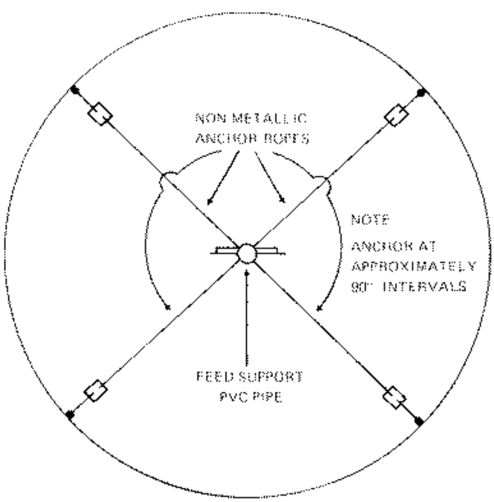



DIAGRAM TWENTY-ONE

(4 - Beyond 12' struts could be worked without pre-stressing, but it is quite a trick to maintain a parabolic form versus a circle pattern.)

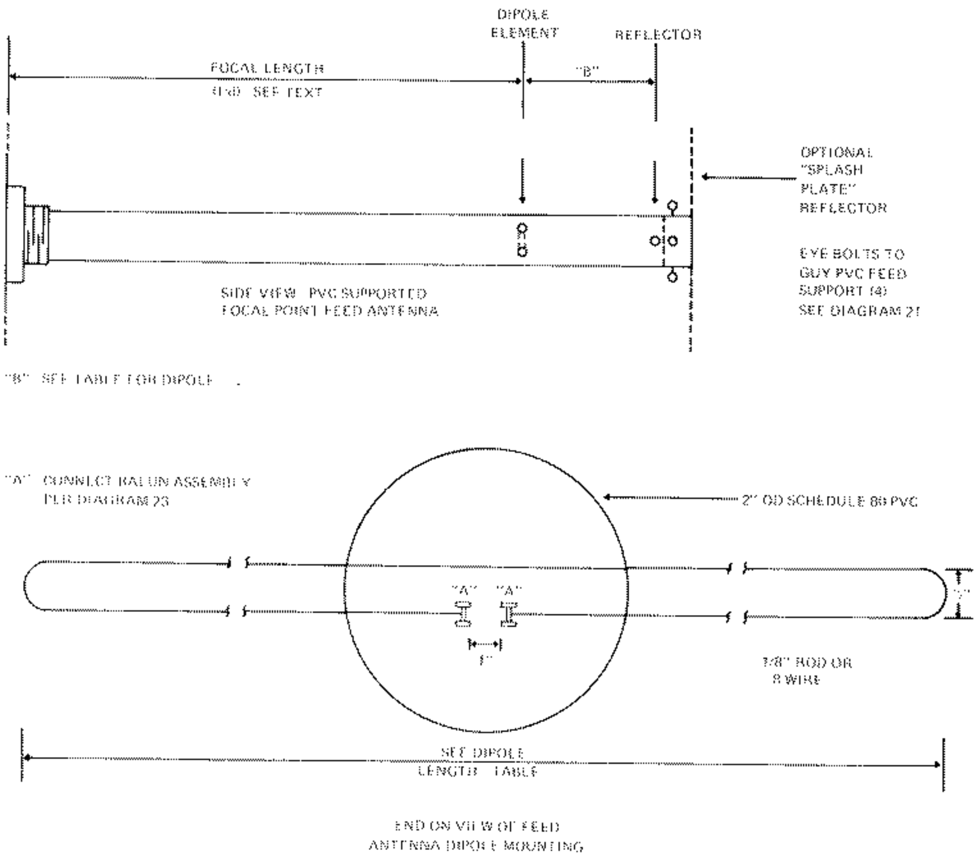



*DIAGRAM TWENTY-TWO*

The use of schedule 80 PVC allows the builder to form a dipole feed antenna in a conventional 300 ohm manner and feed through a coaxial balun (Diagram 22) with 75 ohm cable. The feedline is brought to the rear of the antenna through the PVC where a preamplifier can be mounted, or a downline piece of lower loss cable can be inter-connected for the run into the head end.

**TUNE-UP AND ADJUSTMENTS**

Initially, you will want to verify that the focal point is located either where you believe it should be, or, it really is. Few would trust that if it is precisely where it should be, hang a feed antenna at that point, and walk away.

Experience has shown that with a twenty foot parabolic, the feedpoint will probably be within a few inches of its intended location if you merely eyeball the dish after construction *and* everything looks like it fell into the proper location during construction (i.e. no obvious bulges in the reflective surface, malformed struts, etc.), *at least for high band use.*

At UHF, a redwood constructed 20 foot may have enough cumulative pattern discontinuities to feed it, not readily obvious to the eye, that the feed point or focal point can be shifted a foot or two one direction or the other. The aluminum strut 24 foot (or smaller) is less apt to have this problem at UHF however and the focal point usually trues to within an inch or two or its intended location.

Redwood 30 and 40 foot versions are capable of warping to the points where the feed or focal point shifts as much as a foot to 18 inches at high band VHF and UHF.

Obviously the antenna needs to be proven by probing with a focal point antenna for the exact location of the maximum focal point radiation.

There are two schools of thought about truing a parabolic dish. One suggests that if the pattern is skewed because of errors during construction, you locate the skewed focal point and hang your feed point antennas there.

The second school of thought suggests that after you find the focal point, you measure or mark the location where it was *supposed to be* and then measure the difference in space. If it is more than a few inches off, you should then mount the feed where it is supposed to locate, and start adjusting the dish to bring the pattern back in at the design (intended) focal point location.

If the dish has taken on a something less than true parabolic shape during construction and erection, there will be focal point skewing. Remember that part of the simplified theory for a dish holds that the physical distance from the reflective netting surface to the focal point antenna is everywhere equidistant. This is important if the various components of the reflected (and focused) signal(s) are to be arriving at the focal point antenna *in phase with one another* and add together. If the whole antenna is equidistant except for (say) the right hand outer 20% of the antenna, two things happen. The greater (or lesser) distance for the out-of-true portion not only does not add (in phase) to the balance of the reflected signal(s), it subtracts out some of the energy from the remainder of the 80% which is in phase.

To illustrate, if 20% of the surface were so out of phase that the reflected signals had to travel an extra 180 (phase) degrees (1/2 wavelength) to arrive at the focal point antenna, you would lose more than 20% of the surface to the gain equation. At the same time, that 20% out of phase would cancel 20% additional in phase energy, resulting in a net reflective surface that would be only 60% totally in phase and functioning. Thus your gain, in this simplified example, would be only 60% of what is possible with a dish of the same size which is 100% in phase.

In some situations the cancellation could be much worse.

Recall that with any scatter type of signal, the signal voltage appearing at any specific point on the reflective surface is constantly changing. The scattering propagation mechanism causes the signal level to fluctuate wide-

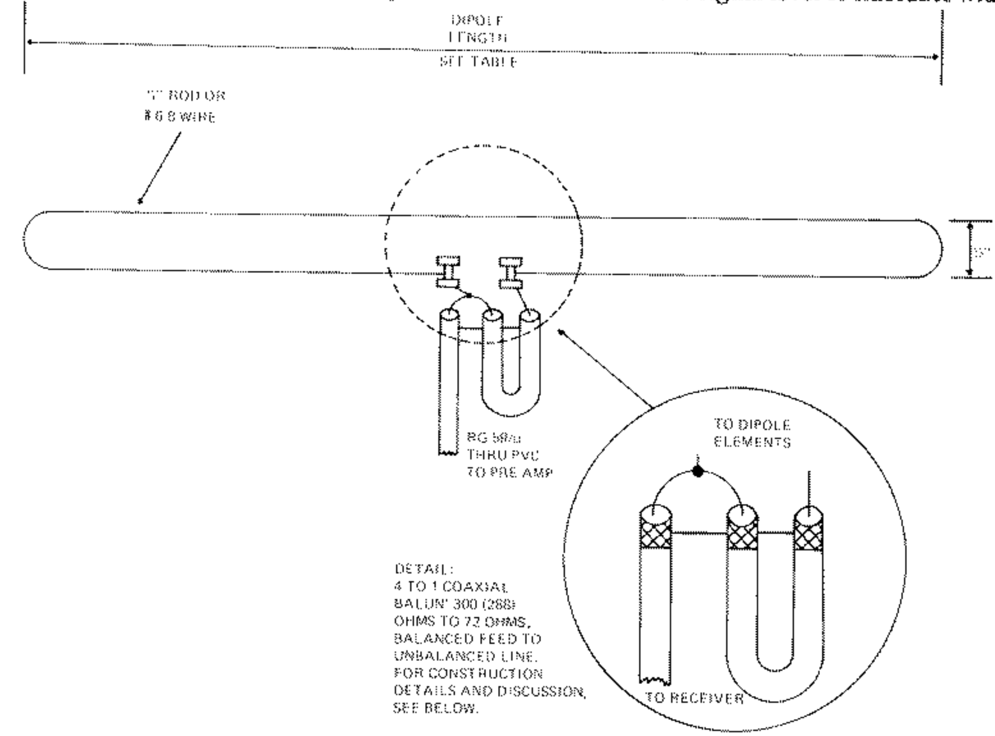



*DIAGRAM TWENTY-THREE*

ly within fractions of a second. If you arbitrarily selected two discreet physical points on the array and attached a field strength meter to those two points, you would quickly see that the signal level at one point typically bore no relationship to the signal level at the other point. At one instant point "A" would be greater, and then in another instant point "B" would be greater.

Hosken in North Bay, Ontario, did a long term study with a bank of 16 channel 4 yagis on the 290 mile signal of WBEN Buffalo, separating various single yagis in the 16 bay array for individual FSM readings. He found (as others have since) that the signal voltage variation from antenna often exceeded a 20 to 1 ratio.

Given this fact of life, as antenna capture area increases relative to wavelength, we often have *uneven illumination* of the dish surface. When this occurs, a surface that is more than 1/16th wavelength out of true from any one point to any other one point begins to become an efficiency-of-antenna problem.

*This is not to be confused with diversity reception techniques; while there is constant signal variation even within an area of a few square wavelengths at the receiving site location, these rapid changes tend to change relations to one another so fast that normal diversity techniques do not apply.*

So while either locating the focal point and tacking the feed antenna there, or locating the focal point and measuring its location relative to where it should be and then correcting the dish to the true focal point, are useable techniques, the latter is a much better choice.

The parabolic surface should be adjusted so that it points dead on the intended signal source. The reflective surface is then tied

**MATCHING THE FEED DIPOLE**

**The feed antenna dipole has a feed impedance of approximately 288 (300 ohms nominal). The feed antenna is a "balanced" antenna. Coaxial transmission line, on the other hand, is an "unbalanced" transmission medium.**

**The conversion from a balanced 288/300 ohm feed dipole impedance to a 72/75 ohm unbalanced transmission line is easily accomplished with a length of coaxial cable that is electrically one-half wavelength long on the antenna operating frequency. Such a 4 to 1 balun is shown here.**

**The physical length of the balun (distance "A" to "B" in Diagram 20) measures from the exposed center conductor to the exposed center conductor. This length varies with frequency, since we are dealing in each case with one-half wavelength (at the operating frequency). The length in actual practice is less than a full half-wavelength in free space, because of something called the velocity of propagation factor in coaxial cables. In normal RG-59/U or RG-11/U this factor results in a line that is actually .65 (65%) of a free space half wavelength. In foam type cables, this length is approximately .80 (80%) of a free space half wavelength.**

**The position of the 4 to 1 balun, with respect to the feed antenna boom, can be important, especially on high band and UHF. In theory, it should hang down, at a 90 degree angle, from the dipole feed element. However, this may not be possible with some forms of construction. The cable can be rolled into a coil for low band channels, but for high band and UHF it should be kept straight as coiling forms an inductor (tuned circuit).**

**CATV operators can also take apart an indoor matching transformer, and utilize the 4 to 1 balanced to unbalanced matching device therein for the impedance step down from the dipole line to the 72/75 ohm coaxial cable. If you do this at UHF, be careful to select a matching transformer which is rated for performance into the UHF region. Typical CATV transformers get very lossy at UHF (or above 250/300 MHz) and should not be used for UHF under any circumstances. However, many consumer line matching transformers (Jerrold, Blonder-Tongue, Winegard, etc.) have VHF/UHF matching units available.**

**To calculate the length of "A" - "B" for a coaxial 4 to 1 balun, use the following formula:**

**"A" - "B" = 468 f x .65 (or .80 for foam cables)**
**f is the operating frequency (use center of channel)**
**The length (answer) is in feet (and fractions thereof)**

down (secured) in that direction, and the feed antenna (or a test feed of the proper 3 db beamwidth) is *probed* in the general area of the intended focal point. This can be done by moving a tripod about on the ground if the parabolic reflector has been installed just a few feet off ground on a tower or pole.

The entire area around the intended focal point should be probed, to verify that the peak reading is in *one* spot. The probe antenna needs to move not only from side to side but up and down in these tests. If the tripod is constructed so that you can slip a mast up and down, the mast can be marked with heights above ground and the heights recorded as you make measurements. The ground location where focusing peaks can be similarily marked.

Experience has shown that the focal point will be abrupt in the horizontal planes (i.e. in and out away from the dish, left and right on a line parallel to the dish) but broad to within a foot or more in the vertical (i.e. up and down) plane. If the focal point antenna can be rotated (i.e. turned on its axis) and the signal level (1) varies slowly, or (2) peaks with the feed antenna *not* pointed directly at the center of the dish, you have (1) something wrong with the feed antenna, or (2) a dish pattern that is skewed. In the latter case if you have to point left of center for maximum signal, the side of the dish *right of center* is not adding in phase signals to your feed antenna.

Once the focal point is found, the feed antenna should then be rotated left to right, and then tilted up and down. This will check the trueness of the reflective surface because *any variation from maximum signal when pointed dead ahead towards the dish center* indicates something is awry with the reflective surface.

If you suspect something is improper with the reflector, make a careful set of notes of the levels found at the maximum *indicated* focal point, and then re-establish the feed antenna at the theoretical center mount location and begin adjusting strut tensions to reshape the dish the best you can, observing the FSM as you do so. If your scanning procedure has indicated that the right of center portion seems to be ineffective, start by re-adjusting back guy strut tension on that portion.

**CO-CHANNEL FOCUSING**

**Users of the 20' and 36'/40' dishes report that while the focal point for the desired station is sharp in the horizontal plane(s), as noted in the text, and relatively broad in the vertical (up and down plane once the horizontal plane has been set), that if there is a co-channel source from 0-90 degrees (left or right of main beam heading) that by moving the feed antenna up and down within the vertical area shown in Diagram 9, that a change of just a few inches (up and down) will often greatly reduce the co-channel intensity (by 20 db or more).**

**Signals entering the reflective surface area from an unwanted transmitter, arriving at an angle other than dead-on, can be phase cancelled by feed antenna position. A little experimentation on your own will show whether you can make your undesireds cancel by moving the feed antenna up and down in the focal region.**

**PROBABLE GAIN FOR VARIOUS DISH SIZES**

**How much gain over a tuned reference dipole, at the same height, could you expect with dishes of various sizes? While the variation from location to location may be +/- as much as 2.0 db from those shown here, this will give you something to shoot for, and to compare to another table with this article which measures gain versus stacked log or yagi arrays.**

| Channel | 10' | 20' | 30' | 40' | 50' | 60' |
|---|---|---|---|---|---|---|
| 2 | nG | nG | nG | nG | 10 db | 11 db |
| 3 | nG | nG | nG | nG | 11 db | 12 db |
| 4 | nG | nG | nG | nG | 12 db | 13 db |
| 5 | nG | nG | nG | 10 db | 11.5 db | 13 db |
| 6 | nG | nG | nG | 11 db | 12.5 db | 14 db |
| 7 | nG | 14 db | 15.5 db | 17 db | 19 db | 21 db |
| 13 | nG | 15 db | 16.5 db | 18 db | 20 db | 22 db |
| 14 | 18 db | 20.5 db | 22 db | 23 db | 24.5 db | 26 db |
| 36 | 18.5 db | 21 db | 22.5 db | 23.5 db | 25 db | 26.5 db |
| 72 | 19.5 db | 22 db | 23.5 db | 24.5 db | 26 db | 27.5 db |

It is usually a good idea to re-check the reflective surface to focal point location distance before you start playing with strut tensions. Take some string and measure out lengths 2 feet longer than you have indicated for focal length (i.e. 10 foot focal length, 12 foot string). Tie one end to the screen netting and mark the string with a piece of tape at 9 feet, 9 foot 6, 10 feet, 10 foot 6 and so on up to the 12 foot end. Tie a number of these strings to the reflective surface and stretch them out towards the focal point antenna. This will give you several instant measurements for the distance from the points on the netting to the focal point, and a constant checking system as you *true* the back guys as to when you are in correct adjustment of the struts so that all of the reflective surface is the proper distance from the focal point antenna. (Simply tie or tape these strings to the driven element on the focal point antenna, at a common spot, and adjust the struts until the string tension indicates the proper f/d distance from all string-indicated surface points on the dish to the focal point dipole element.)

**FEED DIPOLE/REFLECTOR/SPACING**

**Refer to Diagrams 22 and 23. The length of the dipole element (tip to tip as in Diagram 22 and 23), the spacing distance between the dipole element and the reflector ("B" in Diagram 22), and the reflector length are given below for channels 2 - 13, and for selected UHF channels. When using a UHF channel feed, select the channel given in the table below that is closest to the desired channel on the lower channel side, and apply the correction factor given for each channel UP from the table listed channel.**

| Channel | Dipole Length | Reflector Length | Dipole/Reflector Spacing |
|---|---|---|---|
| 2 | 97.33" | 113.9" | 55.9" |
| 3 | 88.05" | 103.04" | 50.6" |
| 4 | 80.40" | 94.08" | 46.2" |
| 5 | 70.22" | 82.17" | 40.3" |
| 6 | 65.26" | 76.37" | 37.4" |
| FM-95 | 58.39" | 68.33" | 33.5" |
| FM-105 | 52.83" | 61.82" | 30.4" |
| 7 | 31.34" | 36.67" | 18.0" |
| 8 | 30.31" | 35.47" | 17.4" |
| 9 | 29.35" | 34.34" | 16.9" |
| 10 | 28.44" | 33.29" | 16.3" |
| 11 | 27.60" | 32.30" | 15.9" |
| 12 | 26.80" | 31.36" | 15.4" |
| 13 | 26.04" | 30.47" | 15.0" |
| 14 | 11.73" | 13.72" | 6.7" |
| 20 | 10.89" | 12.75" | 6.3" |
| 28 | 9.96" | 11.65" | 5.7" |
| 36 | 9.17" | 10.73" | 5.3" |
| 42 | 8.65" | 10.13" | 5.0" |
| 50 | 8.05" | 9.42" | 4.6" |
| 58 | 7.53" | 8.81" | 4.3" |
| 64 | 7.18" | 8.40" | 4.1" |
| 72 | 6.76" | 7.91" | 3.9" |

**For UHF channels not listed, find the closest channel on the lower side listed, and calculate the change per channel from the closest channel listed on the higher side, for each element. Divide by the number of channels between the two listings (typically 8 except for the first two listed) and multiply by the actual channel difference. For example, to find channel 16 dimensions, take the dipole length on channel 14 (11.73") and the dipole length on channel 20 (10.89") and locate the difference (11.73 - 10.89 or 0.84"); divide by the difference of 20-14 (6) (0.84 divided by 6 = 0.14") and multiply this number by the difference between 14 and 16 (2), which is 0.14 x 2 or 0.28". Now subtract 0.28" from 11.73" and you have the dipole length for channel 16 (11.45").**

## SYNOPSIS

By this point, you are either certain you don't want to get involved in such a project, or, hopelessly hooked on the biggest antenna of them all, the parabolic. In either case we hope you have profited from this report, and that if you should construct such an antenna for your own system use, that you will send along some photos and a report of its performance to CATJ.

### APERTURE VS. FREQUENCY

**On the Limited Aperture Theory (2) there is a minimum useful frequency for any parabolic antenna, below which the parabolic refuses to focus or exhibit parabolic traits. The gain at this lowest frequency is not high (approximately 10-11 db over a dipole), but it is useful to know how low you can go in useful frequency with a parabolic of any given size. This table sets the smallest aperture parabolic versus operating frequency data down into one location for handy reference.**

| Frequency | Smallest Useful Dish Size |
|---|---|
| 900 MHz | 3.12' |
| 850 MHz | 3.30' |
| 800 MHz | 3.51' |
| 750 MHz | 3.74' |
| 700 MHz | 4.01' |
| 650 MHz | 4.32' |
| 600 MHz | 4.68' |
| 550 MHz | 5.11' |
| 500 MHz | 5.62' |
| 470 MHz | 5.97' |
| 210 MHz | 13.37' |
| 200 MHz | 14.04' |
| 190 MHz | 14.77' |
| 180 MHz | 15.60' |
| 170 MHz | 16.51' |
| 160 MHz | 17.55' |
| 150 MHz | 18.72' |
| 140 MHz | 20.05' |
| 130 MHz | 21.60' |
| 120 MHz | 23.40' |
| 110 MHz | 25.53' |
| 100 MHz | 28.08' |
| 90 MHz | 31.20' |
| 80 MHz | 35.10' |
| 70 MHz | 40.11' |
| 60 MHz | 46.80' |
| 50 MHz | 56.16' |

**This assumes an f/d of 0.5.**

Ending Alignment Confusion

# MARK-A-CHANNEL SELECTS ANY OF 12 VHF CHANNELS, WITH COLOR AND AURAL!

**FRUSTRATIONS OF MARKING**

Anyone who has been around CATV for any length of time has suffered from the *frustrations* of trying to align a precision device such as a bandpass filter, trap, strip amplifier or adjacent channel trap with the conventional type of CATV markers.

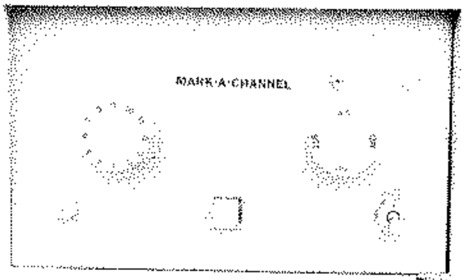
Unless you are fortunate enough to have precise on-channel and adjacent channel markers in your sweep system (1), you have been using some type of marker machine such as the RCA WR-99A. This is a fine piece of equipment, costing about $300.00, but it is a little tedious to use and there is plenty of room for operator error. First you locate the 10 MHz marker and zero it with the pointer on the nearest 10 MHz mark on the dial. Then you turn on the 1 MHz markers and start counting down (or up) until you are in the vicinity of, or on, the correct MHz that is nearest to your desired marker carrier frequency. Finally you zero in around the vicinity of the 1/4 MHz marker region, trying to sort out the 1/10th MHz marks as you go. It is very easy to be 1, 1-1/4 or more MHz off of frequency. And when you are aligning a piece of gear that *must* be on frequency, that kind of error can be a disaster.

In the WR-99A, the 4.5 MHz modulation (second marker) is a nice feature, except for the fact that you also get a minus 4.5 MHz carrier marker as well. This can be a real problem on some of the older test set ups since a simple reversal of the plug on the scope can produce a change in the direction of the sweep. Many a bandpass filter has been erroneously aligned to pass the visual carrier frequency plus the *lower* sideband, attenuating the upper sideband when you thought it was the other way around as you tediously aligned the beast!

Those who do not belong to the WR-99A school of hard knocks have cut their teeth on scope screen linearity trying to utilize the 50,10 and 1 MHz markers provided as standard equipment on many modern sweep units. As long as the sweep *is linear,* the detector *is flat* and the scope *is in perfect adjustment*, you can accurately *eyeball* .25 MHz *spaces* between the markers and come pretty close. But setting adjacent channel traps with interpolation of *spaces between markers* is at best risky. Some of today's traps are so sharp that a 3-5 db error can easily pass by, simply because you were 100-200-300 KHz off in where you interpolated the .25 MHz marker *point* should fall, between *real* 1 MHz marker spots.

In sweeps with built-in 50,10 and 1 MHz markers, a moment of laxity can get the technician as much as 50 MHz off of where he thinks he is.

It was with all of the preceding facts in mind that the design of the Mark-A-Channel was undertaken. The design criteria was as follows:




*by:*
*S.K. Richey*
*Richey Development Company*
*Oklahoma City, Oklahoma*

(1) *Crystal stability* (good-bye WR-99A tuning procedures!)

(2) *Switch selectable tuning* (ditto, plus good bye reading 50,10,1 MHz markers as they "sweep by")

(3) *Addition of 4.5 MHz audio* with the visual carrier frequency

(4) *Addition of 3.58 color* with the visual and aural carrier markers

(5) *Supression of the lower sidebands* (good bye to wrong channels by error)

(6) *Ease of construction* (this *is* a do-it-yourself construction project!)

(7) *Low cost* (well, lower than a WR-99A anyhow)

The easiest way to generate 12 crystal controlled carriers is to utilize 12 crystals. But alas, crystals cost money and even at $5.00 a pop that is at least $60.00 for the crystals alone. There would be 12 separate and discreet oscillators with all of their transistors and small component parts.

If we went directly on channel with individual oscillators, this would mandate that we have 12 separate built-in bandpass filters or traps to handle the supression of the lower sideband. Scratch 12 separate oscillators.

So using modern *crystal synthesis* techniques, how *few* crystals could we utilize and still generate all of the carriers we need (12 channels, 3 carriers per channel, or 36 markers in all)? The answer was astounding.

*Four crystals.*

Egads you say. How can that be so?

**THEORY OF OPERATIONS**

The heart of the Mark-A-Channel (2) is a 6 MHz crystal controlled oscillator and a comb generator. A comb generator is an amazing bit of electronic wizardry which has a single carrier frequency at its input, and then gobs of multiples of that input frequency at its output. Our 6 MHz oscillator runs through the magic of the comb (the name is derived from the tooth-on-a-comb like appearance of the output when displayed on a sweep set up) and produces carriers at 6, 12, 18, 24, 36, 42, and 48 MHz (see Diagram 1).

Now the output of the useful comb is fed into a 12 to 48 MHz tuneable amplifier. We tune this amplifier by *switching diodes* which in turn activate tuning capacitors C1 through C7. Thus by switching in the particular capacitor (C1 or C2, etc.) which appears across the 12-48 MHz amplifier, we select *just one* of the comb output frequencies one at a time.

The 12 MHz comb is utilized for channels 2, 5 and 7. The 18 MHz comb output is chosen for channels 3, 6 and 8. The 24 MHz comb is utilized for channels 4 and 9. The 30 MHz comb, the 36 MHz comb and the 40 and 48 MHz combs are utilized for channels 10,11,12 and 13 (respectively).

The output of the 12-48 MHz amplifier is split in a DC-10 (directional coupler) and fed into a single balanced mixer. Here is the 3.58 and 4.5 MHz carriers are added to the circuit. One of the more interesting features of a single balanced mixer is that it *rejects* (attenuates) the input signal and only allows the sidebands to appear at the output (see Figure A). At the output we cleverly design in a series of tuned trap consisting of L2 and C8 through C14. The trimmer capacitors are switched in and out of the cir-

**TABLE ONE — MIXING FREQS**

| Channel | Low F + | Local Osc. = | Pix Carrier |
|---|---|---|---|
| 2 | 12 MHz | 43.25 MHz | 55.25 MHz |
| 3 | 18 | 43.25 | 61.25 |
| 4 | 24 | 43.25 | 67.25 |
| 5 | 12 | 65.25 | 77.25 |
| 6 | 18 | 65.25 | 83.25 |
| 7 | 12 | 163.25 | 175.25 |
| 8 | 18 | 163.25 | 181.25 |
| 9 | 24 | 163.25 | 187.25 |
| 10 | 30 | 163.25 | 193.25 |
| 11 | 36 | 163.25 | 199.25 |
| 12 | 42 | 163.25 | 205.25 |
| 13 | 48 | 163.25 | 211.25 |

(1) *Such as Wavetek unit with built-in on channel and adjacent markers .*

cuit as required for the various channels which you select with the single knob front panel channel selector control.

Therefore, at the input to the two-way splitter (see Figure A) we end up with only the *plus* or upper sideband 3.58 and 4.5 MHz information. At the other input to the two-way splitter (which we are using here to combine signals together, *not* split apart), the original carrier (first split out in the DC-10) is re-inserted. And here is the magic. At the output of the splitter used as a combiner, we have (1) *a visual carrier,* (2) *a color sub-carrier,* (3) *an aural carrier set of markers, but, no lower sideband!*

All that remains for the magic box is to take this wondrous collection of marker signals and place them in the appropriate spot in the RF spectrum to match up with the

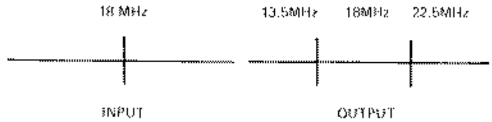


*FIGURE A*

TV channel assignments of channels 2-13. This is accomplished by taking the output of the previously detailed two-way splitter used as a combiner and feeding it into a double balanced mixer where it is mixed with the appropriate local oscillator to give us the desired TV channel.

As a for instance, to get the 12 MHz (dedicated) marker with 3.58 and 4.5 MHz *subcarriers* up to 55.250 MHz, we must mix the 12 MHz with a 43.25 MHz oscillator.

After the ingenious mixing work of the

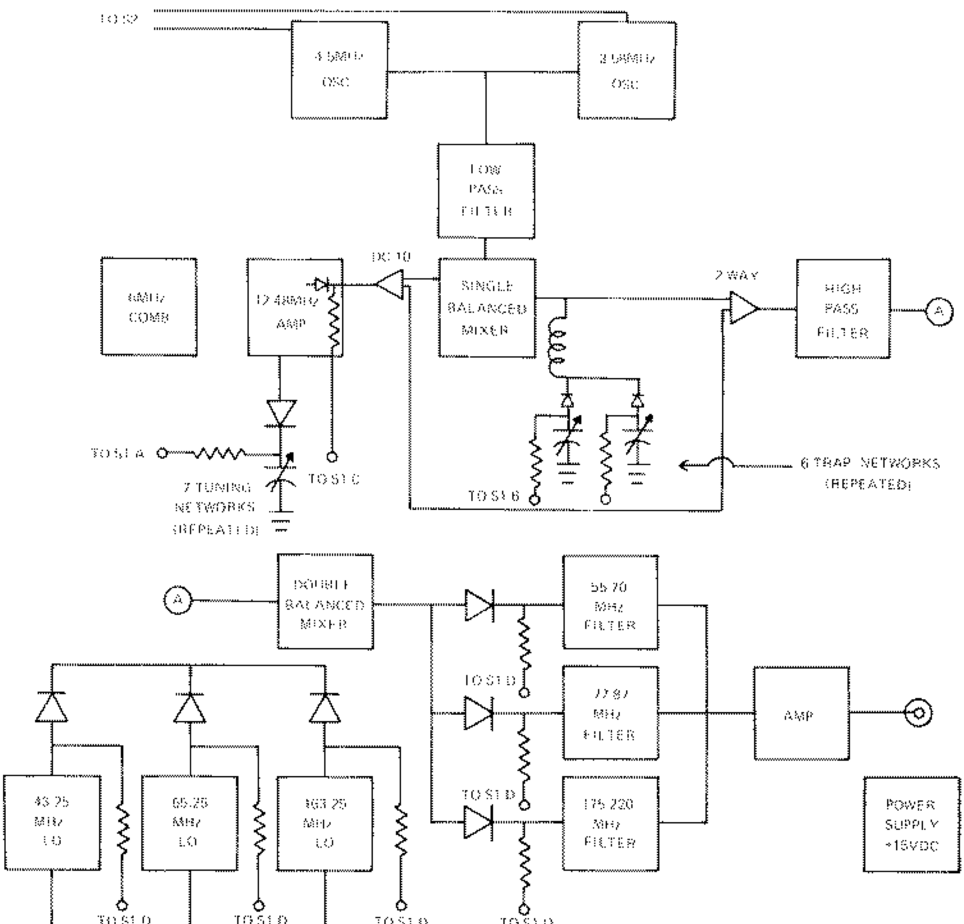


*DIAGRAM 1*

double balanced mixer, the output is run through a filter for the channel range it is working in. There are filters for channels 2,3,4; 5,6; 7,8,9,10,11,12 and 13 (three filters in all). The appropriate local oscillator and the appropriate filter are switched into the circuit by using switching diodes activated by the "D" section of switch 1 (appropriately, switch 1D).

After broad bandpass filtering (to handle any outputs not in the appropriate range) the signal is applied to a final (output) amplifier stage, and fed to the output "F" fitting.

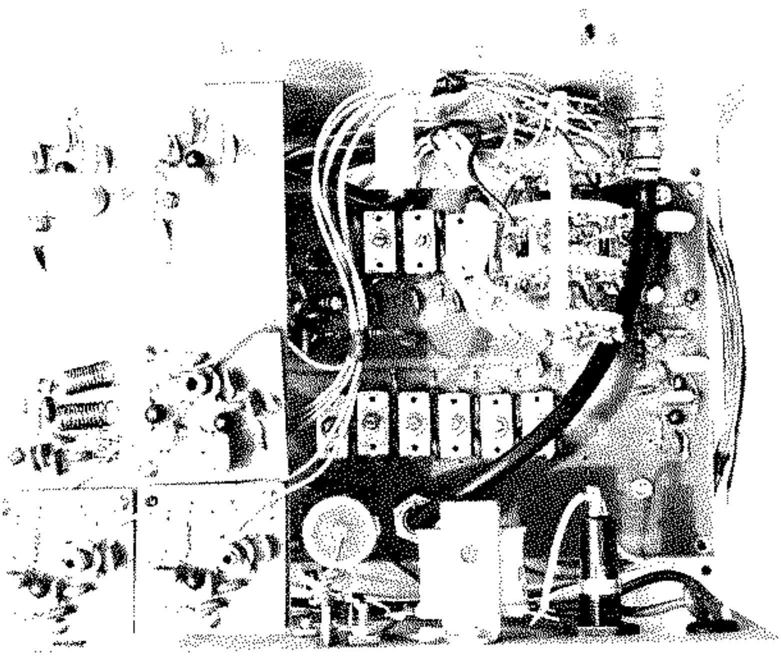
Powering for the Mark-A-Channel is straight forward and is essentially the same as the power supply circuit shown in the 10 channel marker featured in the May issue of CATJ (Volume 1, Number 1).

If you still are pondering how so few crystals can do so much work, take a gander at Table 1 here. As you can see, the basic 6 MHz oscillator (with combs at 12-48 MHz in 6 MHz increments) is mixed with three other oscillators that function at either 43.25 MHz, 65.25 MHz or 163.25 MHz. Who says electronics has to be complicated?

*KIT CONSTRUCTION*

In the inaugural issue of CATJ (May) we described a crystal controlled marker for specific marker functions such as band edge marking and radiation tests. The article was prepared as a do-it-yourself construction article, as is this article. Recognizing that not everyone has the experience to wire up from scratch a unit such as that, we offered a "kit" of parts and circuit boards. A number of readers took us up on that and we assume the kit builders were satisfied with the results.

Construction of a "kit" falls into a couple of categories. Most everyone has had some experience with Heathkits; it is hard to go wrong with a Heathkit, even if you have never held a soldering iron in your hands before. Then there are magazine articles, such as this one, which offer kits of parts and circuit boards. Magazine article kits tend to be for the more experienced builders; that is, someone who has a working knowledge of component parts and a basic grasp (at least) of what the unit they are building does. Magazine article kits are not step-by-step projects ala the fine work done by Heathkit.



Additionally, for every reader out there who might want to build up this unit from the kit, there are quite a few who would like the unit for their CATV work, but who would not tackle the kit. We have an answer to that one this month. The kit described here is available as a wired and tested unit as well.

Why go to all of this trouble? Well, it is like this. Our series on CATV test equipment is intended to fill voids in available test equipment for the CATV system. We are not out to compete (heaven forbid!) with existing test equipment manufacturers. In fact, we would be delighted if after our research and development work someone like Larry Dolan of *Mid-State* came along and put such a unit as we describe here into production. But in the interim, we offer the project for anyone who wants to (1) procure the parts on their own and build it, (2) procure the parts from us and build it or, (3) buy the unit wired and tested.

The green tear out card between Pages 8 and 9 of this issue include a tear-out card for ordering the parts or the unit described here.

**CONSTRUCTION**

Begin construction of the smaller circuit board initially. This is the board with the 3.58 and 4.5 MHz oscillators and, the plug-in oscillator boards for 163.25, 65.25 and 43.25 MHz.

Mount all parts for the 4.5 MHz oscillator (this is the oscillator with the physically smaller crystal). The only part that is critical in this portion of the circuit is L65, which has 10 turns of one color wire and 2 turns of a second colored wire. *Make sure the 10 turn side goes to the collector of Q6.*

Note: The circuit boards provided with the kits are silk screened for parts location, called out by the part number in the master list appearing here. The schematics appearing with this article refer to parts by assigned part number, while the parts-list table describes what *Q1*, etc. are. In mounting parts on the circuit boards supplied with the kit, the builder simply follows the silk screened designations.

Construction of the 3.58 MHz oscillator is similar to the 4.5 oscillator. Again, the many turns side of L6 goes to the collector of Q7.

Next wire in the diode switching section of the same circuit board, being careful to watch the polarity of the diodes as they are mounted.

The three local oscillators (163.25, 65.25 and 43.25 MHz) are pre-wired from the kit supplier. The circuit for the oscillators is included (it is the same as the plug in oscillators described in the May CATJ) and they can of course be duplicated from scratch by anyone familiar with such construction techniques. On the assumption you are working from a kit, mount the oscillators in the appropriate positions (see Figure B) on three screws with 1/4 inch standoffs. When mounting the 65.25 and 43.25 MHz oscil-

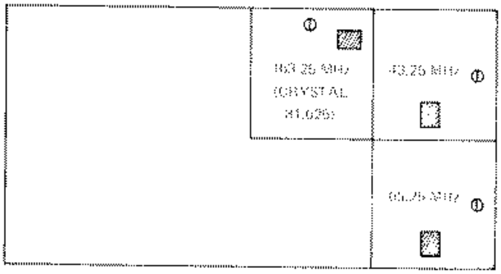



*FIGURE B*

lators, add two right angle brackets to the underside of the board. Turn the master (small) board over and solder wires to the holes provided at the junction of R29/C81, R30/C82 and R31/C83. These wires will be connected later as will the wires coming from the three plug-in oscillator modules.

With the small circuit board (for oscillators) out of the way, set it aside and start on the large master circuit board.

(A) Place all of the inductors on the board; pay particular attention to L1 making certain the six turn side of this coil goes to the collector.

(B) Mount all resistors on the board.

(C) Install all capacitors, *except* trimmers.

(D) Install all diodes, paying attention to the diode polarity shown.

(E) Install all transformers, with particular attention to T6. Make certain that five turn side of T6 goes to B+ and L30/C66 while the two turn side goes to Q5.

(F) Install the transistors.

(G) Install the 6.00 MHz crystal and the SRA-1 mixer.

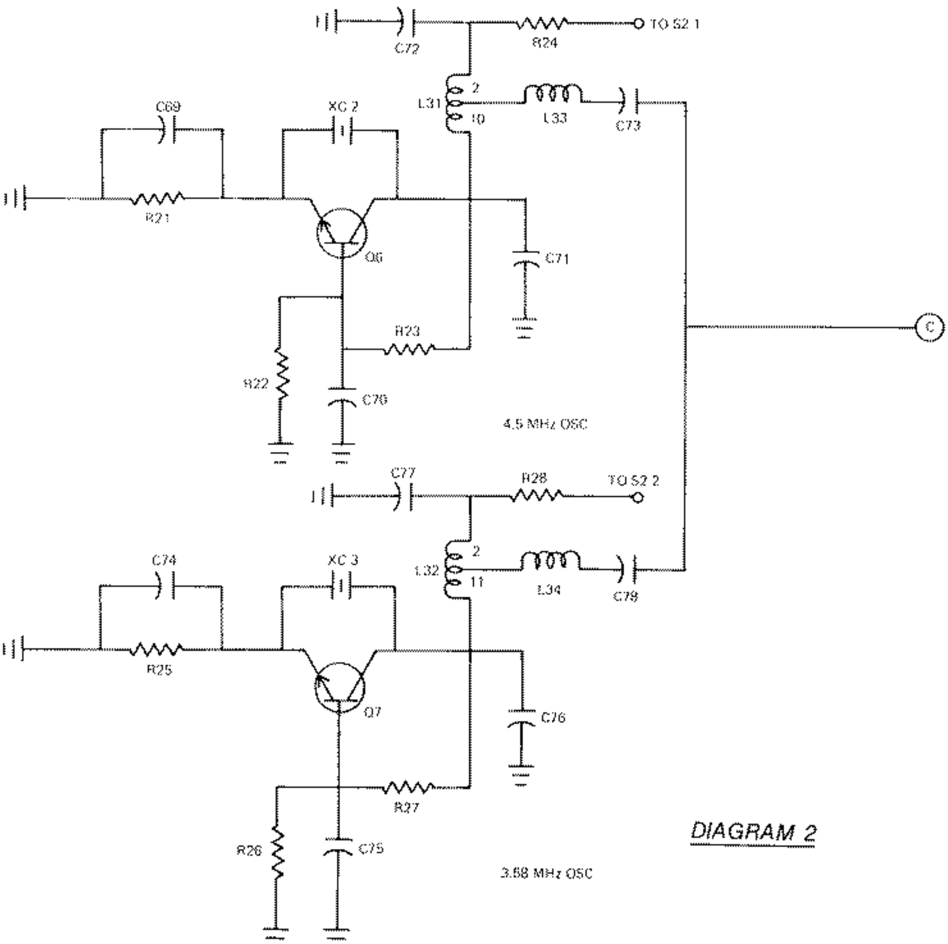



*DIAGRAM 2*

(H) Install all trimmer capacitors, checking to be sure that the end of the trimmer which is common with the adjusting screw goes to ground (check with an ohmmeter).

(I) Install the F-61 connector.

(J) *Turn the board over* and install six 12 inch long wires to the following component junctions: L15/C40, L16/C41, L17/C42, L18/C43, L19/C44, L20/C45. Leave the board turned over for the following five steps.

(K) Install seven 10 inch long wires to the following component junctions: L4/C39, L5/C14, L6/C15, L7/C16, L8/C17, L9/C18, L10/C19.

(L) Install two 10 inch long wires to the following component junctions: R7/C27, R8/C28.

(M) Install three 12 inch long wires to the following component junctions: R13/C50, R14/C51, R15/C52.

(N) Install underneath the board (i.e. on bottom) a jumper between C20 and C67, and another from C67 to C29. Here we are tieing 15 volt (+) lines together so that in the next step we can common-connect them to a +15 source.

(O) Install a single 10 inch wire to C20.

(P) Install one end of a 1/2 watt 680 ohm resistor at point *AA*, leaving the opposite end free for the moment and full length (do *not* cut).

(Q) Go to the master drawing on switch S1 and proceed to wire up the various switch sections as shown. Looking at the back of the switch make pin number 13 at about the 9 o'clock position and then proceeding clockwise count starting from 2 (these will be channel numbers). The gang furthest away from the front panel is Section "A" and Section "D" is the gang closest to the front panel.

(R) Wire up switch S-2 (marker carrier selector) as shown in the drawing, connecting 5 inch wires *from* pins 1 and 2. 2.

(S) Install the fuse holder, power transformer and power supply on the back of the chassis, wiring up the power supply as shown in Figure "C".

(T) Install power transistor Q6.

(U) Prepare a pair of 5 inch wires by twisting them together (twisted pair as it were); solder one to Point "C" (single balanced mixer section) and one to ground at that point. Color code so you know which

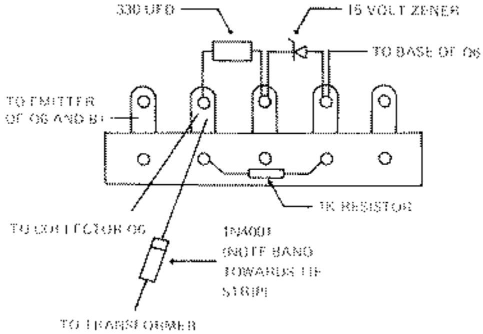



FIGURE C

is ground and which is to Point "C".

(V) Prepare a 5 inch length of miniature 75 ohm coax, connect the center conductor to Point "D" on the double balanced mixer region, the shield to ground at that point.

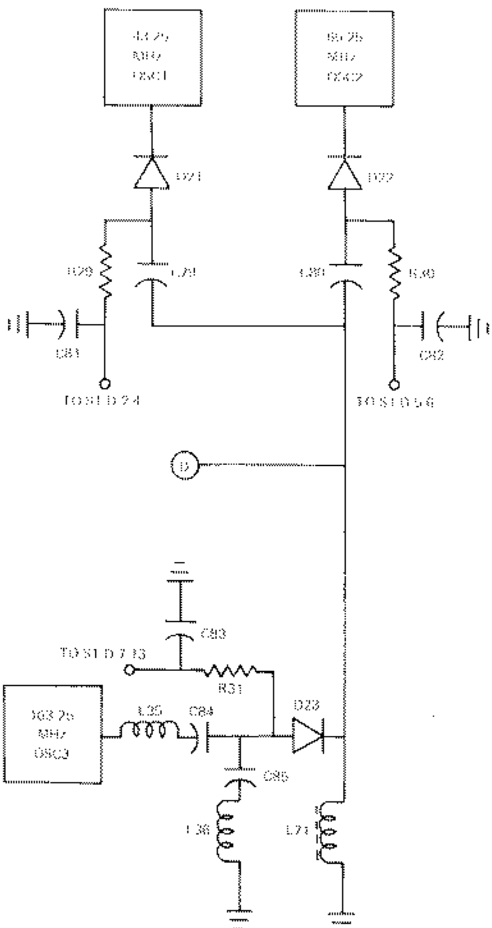



DIAGRAM 3

(W) Install the five 6:32 x 3/4 inch screws through the bottom of the case. On the top side of the case slide a 1/4 inch spacer over the screws and secure with a 6:32 nut.

(X) Place the large circuit board in place and secure finger tight with five 6:32 nuts.

(Y) Install switch S1 into the chassis.

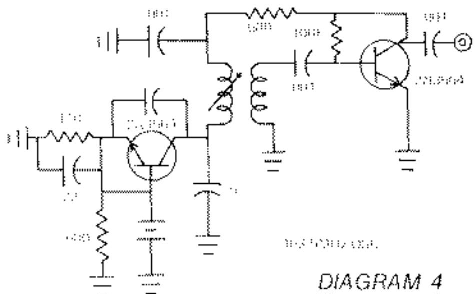


DIAGRAM 4

**INTER-WIRING HARNESSES**

(A) Locate the group of wires coming from the tuned amplifier section and using an ohmmeter connect them in the following order:

| *Wire From* | *Connect To* |
|---|---|
| L4/C39 | S1A-13 |
| L5/C14 | S1A-12 |
| L6/C15 | S1A-11 |
| L7/C16 | S1A-10 |
| L8/C17 | S1A-9 |
| L9/C18 | S1A-8 |
| L10/C19 | S1A-7 |

(B) Locate the group of wires coming from the series trap section and using an ohmmeter to locate the proper wires, connect as follows:

| *Wire From* | *Connect To* |
|---|---|
| L15/C40 | S1B-13 |
| L16/C41 | S1B-2 |
| L17/C42 | S1B-12 |
| L18/C43 | S1B-10 |
| L19/C44 | S1B-9 |
| L20/C45 | S1B-8 |

(C) Locate the two wires coming from R7 and R8 and connect them as follows:

| *Wire From* | *Connect To* |
|---|---|
| R7/C27 | S1C-7 |
| R8/C28 | S1C-8 |

(D) Locate the three wires coming from the filter section, and using an ohmmeter to locate the proper wires, connect as follows:

| *Wire From* | *Connect To* |
|---|---|
| R13/C50 | S1D-2,3,4 |
| R14/C51 | S1D-5,6 |
| R15/C52 | S1D-7,8,9,10,11,12,13 |

CONTINUED ON PAGE 42

# LAST ( free sample ) CATJ

More than 20,000 copies of CATJ ago we set out to acquaint the CATV industry with a new monthly technical publication. Ours. Effective with the very next issue of CATJ (August) the introductory period of CATJ ceases. To continue receiving CATJ, if you have not yet subscribed, you must enter your subscription now. And to be certain that you receive the next (August) issue, we must have your subscription in our hands not later than August 1st. On the opposite side of this insert card is a subscription form. Another is found between pages 8 and 9 of this issue. Do it today!

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Are satellite-to-CATV head ends transmissions more industry blue sky? CATJ thinks not. A satellite now in operation is beaming ETV programming to three USA areas. CATJ looks into the project, and describes in "you-can-build-it" detail a complete CATV earth receiving station which you can construct on your own for well under $1,000.00! CATA has already asked the FCC for a blanket waiver to allow CATV systems to carry this signal. Imagine having a new channel, one from space, on your system by September! CATJ tells you how in the August issue.

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Now that we have completed our introduction program of sending free sample copies to people whom we knew about to begin with, we are asking you to tell us about someone in your "circle" who has not received a copy of CATJ. We will send them a sample, if you will take a minute to tell us who he is and where to send it. Thanks!

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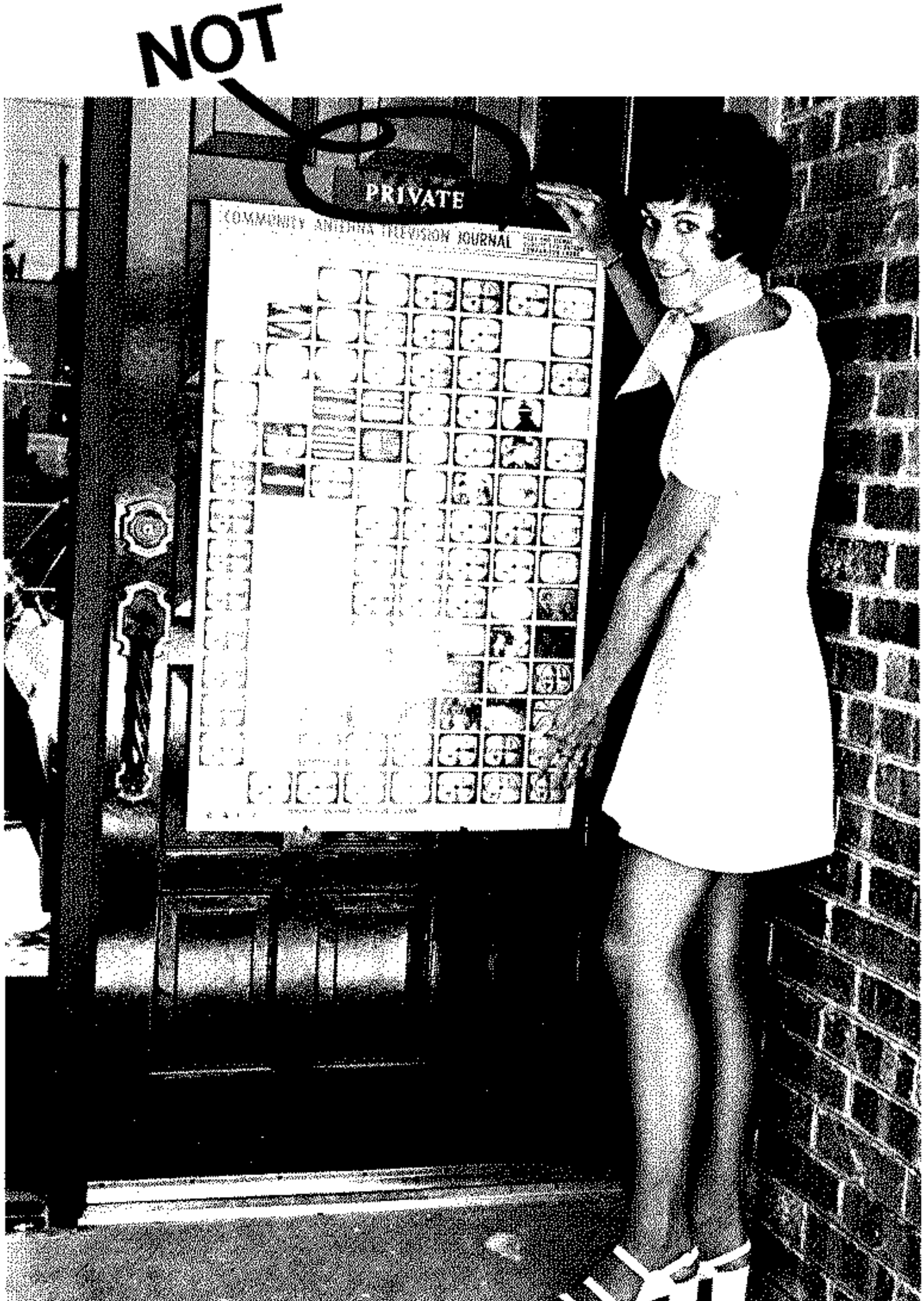
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COMMUNITY ANTENNA TELEVISION JOURNAL

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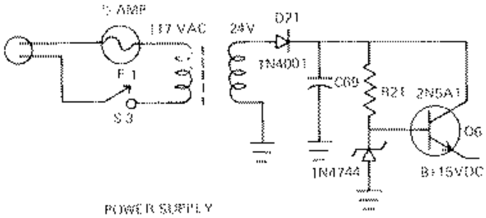



DIAGRAM 5

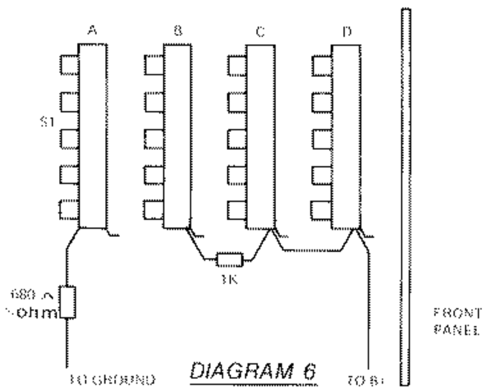



DIAGRAM 6

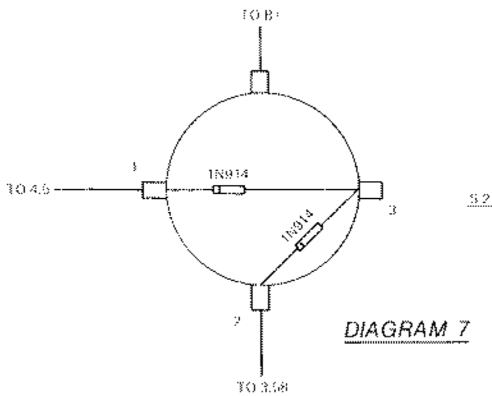



DIAGRAM 7

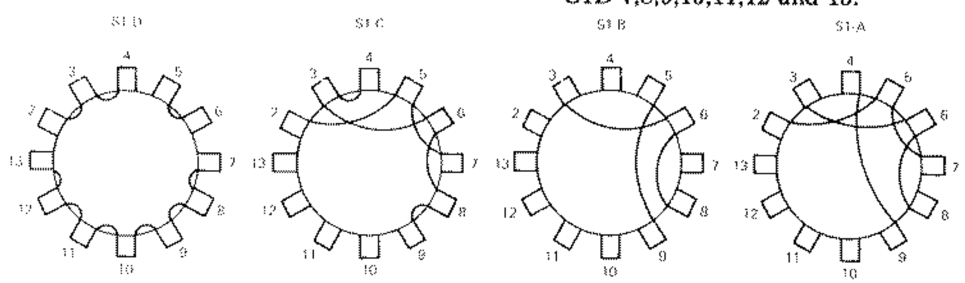



DIAGRAM 8

(E) Locate the free end of the 680 ohm resistor, 1/2 watt, and connect to the common switch point on S1-A.

(F) Install switch S-2.

(G) Now install the two remaining right angle brackets on the small (oscillator) circuit board and then install the board on the chassis with four 6:32 screws.

(H) Locate the miniature coaxial cable that connects to point "D" on the double balanced mixer and connect the free end to point "D" on the small circuit board (underside), with shield to circuit board ground.

(I) Locate the twisted pair coming from point "C" on the single balanced mixer; connect the hot portion of the pair to point "C" on the underside of the small (oscillator) circuit board; connect the other 1/2 of the twisted pair to chassis circuit board ground nearby.

(J) Connect the wire connected from pin 1 of switch S-2 to R24 on the underside of the small circuit board. Connect the wire from pin 2 in the same way to R28.

(K) In the following steps the three oscillators are connected to the switching of S1D which applies power to the oscillators and to the switching diodes.

(1) Locate the wire protruding from the 43.25 MHz oscillator (B+ line) and the pigtail from C81/R29 on the small board; connect both to S1D-2,3 and 4.

(2) Locate the wire protruding from the 65.25 MHz oscillator (B+ line) and the pigtail from R30/C82 on the small board; connect both to S1D-5,6.

(3) Locate the wire protruding from the 163.25 MHz oscillator (B+ line) and the pigtail from R31/C83 on the small board; connect both to S1D-7,8,9,10,11,12 and 13.

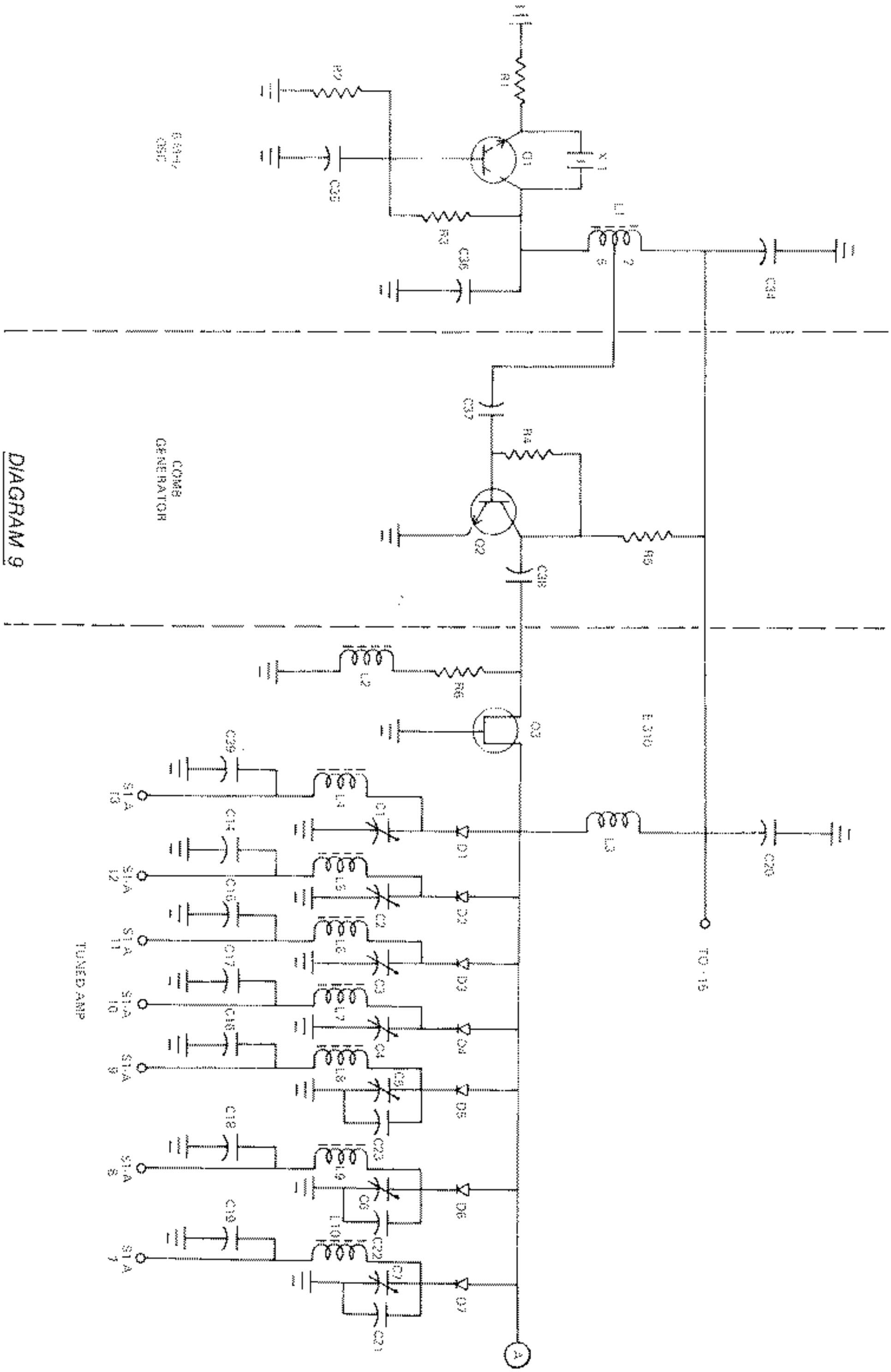


DIAGRAM 9
COMB GENERATOR
TUNED AMP

(L) Install the fuse, pilot light, switch S-3 (power on/off switch) and wire up to the power transformer.

(M) Plug the unit in and turn on; check for voltage level present *at the emitter* of power transistor Q6. *It should read 14-15 volts DC.*

(N) Unplug the unit, and connect the wire from C20 to the output binding post on the power supply.

(O) Connect a wire from the inside (common) lug of S1-D to the power supply.

(P) Connect the wire for B+ from S1 to the inside (common) lug of S1-D.

(Q) Position the turret on switch S1 so that the wiper connects to pin 13 (i.e. channel 13); install the front panel knob so that 13 points up.

INITIAL CHECK OUT

(A) Connect the output of the Mark-A-Channel to the external marker input on your sweep generator.

*NOTE: This unit is designed to function only with a sweep system that has a provision for external marker addition. If your sweep system does not have this provision, the Mark-A-Channel will not function properly. However, in the next issue of CATJ (August issue) we will present a marker-adder circuit for external marker addition so that the Mark-A-Channel can be utilized with virtually any test set up.*

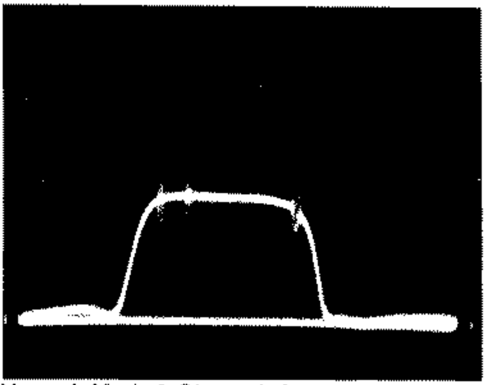
(B) Turn switch S-2 (marker selection) as far as it will go counter clockwise and install the knob with *off* up.

(C) Replug the unit into AC power and turn on. Turn the channel indicator knob (S-1) to 7 (for channel 7) and locate the marker on your sweep. Locate C7 (last in line, under the pilot light) for maximum indicated marker output.

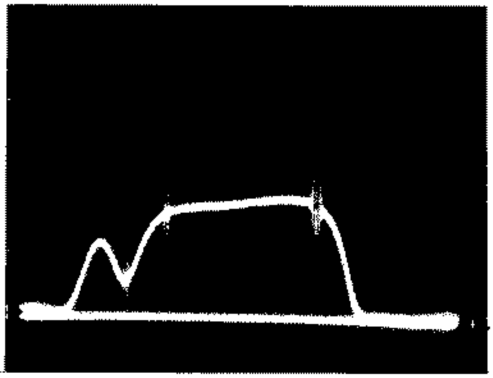
(D) Turn channel indicator to 8 and peak up C6 for maximum indicated marker output. Repeat for channels 9-13, and trimmers C5 etc. until each of the high band channels have been peaked for marker output levels.

(E) Turn the channel selector (S-1) back to channel 7 and switch S-2 (marker selection) to the 4.5 MHz position. You should now see the visual carrier *plus* the 4.5 MHz audio carrier, the latter being either right or left of the visual carrier. Make a note as to which side it appears on; this will be termed the *correct* side and will be the standard for your sweep system for tune up of the other channels.

(F) Turn the channel selector switch to 8 and note that you now have audio carrier(s) indicated on *both* sides of the visual carrier. Using C9 (the trimmer closest to the 6 MHz crystal) and referencing to the channel 7 test where your display had the aural carrier either right *or* left of the visual carrier, tune C9 so that the incorrect (i.e. *unwanted*) 4.5 MHz carrier drops away (i.e. is nulled out). This maintains the aural carrier display on the *same side of the visual carrier* as with channel 7.



Use of Mark-A-Channel for single channel strip alignment.



Checking sound notch (left marker) with sound, color, visual (left to right).

(G) Repeat this process for channels 9 - 13, using trimmers C10 through C14 to null out the unwanted 4.5 MHz sideband for each channel. Remember, the 4.5 MHz side carrier is to be on the same side (left or right, depending upon your sweep and display system) for all channels. Adjusting C9-14 can notch either side, but you only wish to *notch one side*, and then always the

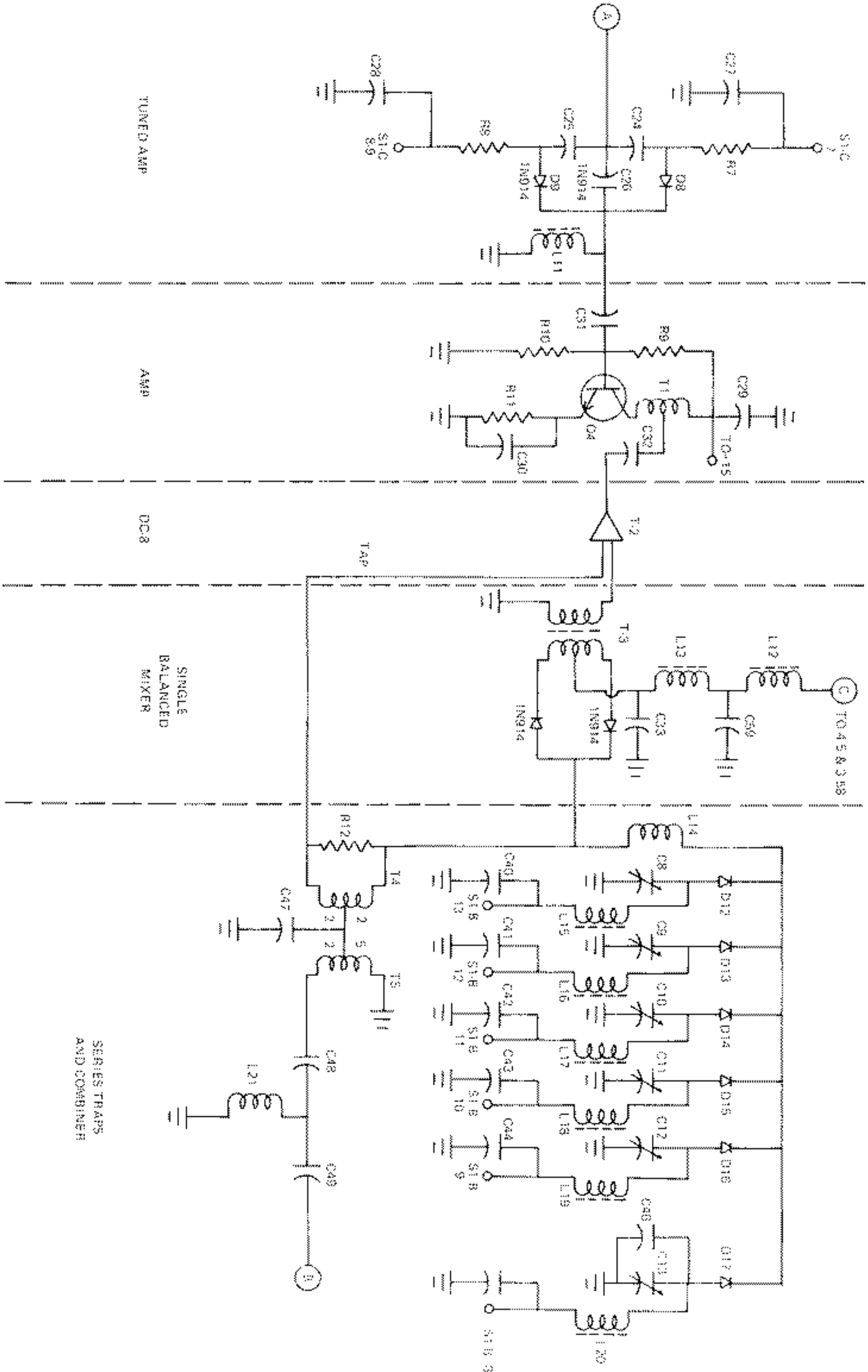

TUNED AMP
AMP
OC-8
SINGLE
BALANCED
MIXER
SERIES TRAPS
AND COMBINER
TAP
TO-15


DIAGRAM 10

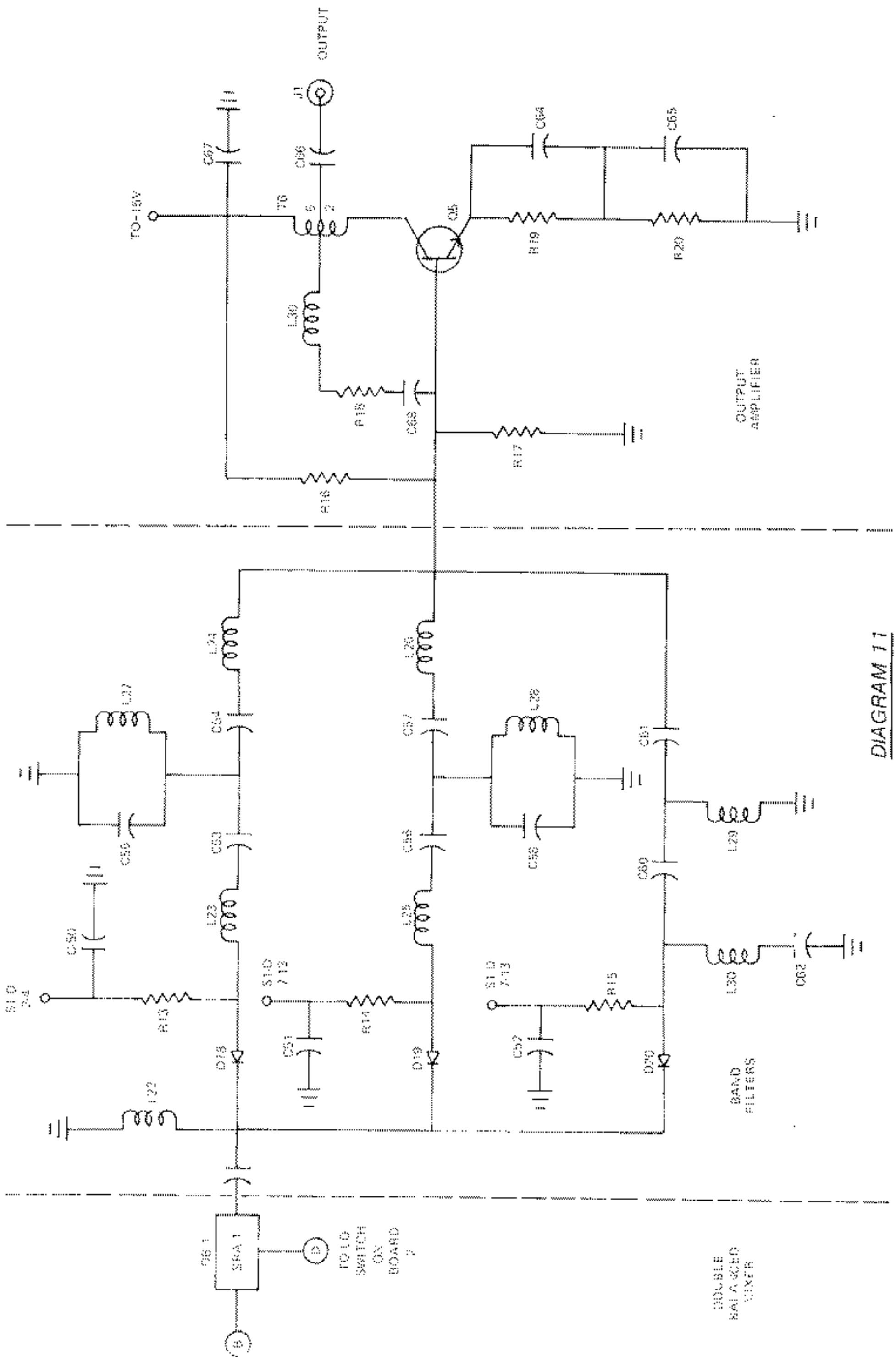

OUTPUT
OUTPUT AMPLIFIER
BAND FILTERS
DOUBLE BALANCED MIXER
TO LO SWITCH ON BOARD 7

DIAGRAM 11

same side to maintain integrity of your Mark-A-Channel unit.

(H) Turn S-2 to 3.58 and swing through channels 7-13 to see that you have visual carrier *plus* 3.58 on all channels.

(I) Turn S-2 to 3.58 + 4.5 and repeat through all high band channels. You should have visual, color and aural on all channels.

(J) Now check the low band channels (2,3,4,5 and 6). They should be operational with no additional adjustments required.

(K) Install a 6 inch jumper of RG-59/U from the circuit board output to the output connector on the front panel; install the cover, and you are completed!

MARK—A—CHANNEL PARTS LIST

| | |
|---|---|
| *Q1,4,5,7,8* | 2N3564 |
| *Q2* | BFX-89 |
| *Q3* | E-310 |
| *D1,2,3,4,5,6,7* | 3080 pin diode |
| *D8-23* | *1N914* |
| *R1,11* | 240 ohms |
| R2,5,10,17,22,24,26 | 680 ohms |
| *R3,7,8,9,13,14,15,16,23, 27,29,30,31* | 3.3K ohms |
| *R4* | 100K ohms |
| *R6* | select for 10MA E310 drain current |
| *R12* | 150 ohms |
| *R18* | 330 ohms |
| *R19* | 10 ohms |
| *R20,21,25* | 110 ohms |
| *R28* | 510 ohms |
| *C1-13* | Elmenco 422 trimmer |
| *C20,34,72,77* | .1 mfd |
| *C21,59* | 390 pf |
| *C22,48,49* | 150 pf |
| *C23,55,76* | 68 pf |
| *C24,58* | 50 pf |
| *C25,85* | 6.8 pf |
| *C26* | 2.2 pf |
| *C30* | 180 pf |
| *C33* | 500 pf |
| *C36* | 120 pf |
| *C46,71,78* | 100 pf |
| *C47,53,54* | 8 pf |
| *C56,57* | 3.3 pf |
| *C60,61* | 10 pf |
| *C62* | 5 pf |
| *C64* | 18 pf |
| *C69,73,74* | 47 pf |
| *C84* | 1 pf |
| *C14,19,27,29,31,35,37,45,50,52, 65,67,70,75,79-83* | .001 mfd |
| *XC-1* | 6.000 MHz |
| *XC-2* | 4.500 MHz |
| *XC-3* | 3.580 MHz (*) * 3579.545 kHz |
| *J1* | F61A |
| *L1* | 7 turns tapped 2 (56-590-65/4B core #30) |
| *L2,11,22,37* | 6 turns on 4B #30 core |
| *L3* | 33 uH |
| *L4,5,6,7,8,9,10,15, 16,17,18,19,20* | 65 uH |
| *L12,13* | 8 turns on 4B core #30 |
| *L14,23,24,25,26* | 82 uH |
| *L21,28* | 3 turns #20, 1/4"diameter |
| *L27* | 4 turns #20, 1/4"diameter |
| *L29* | 2 turns #20, 1/4"diameter |
| *L30* | 9 turns #22, 1/8"diameter |
| *L31* | 12 turns tapped at 2 on 4B core #32 |
| *L32* | 13 turns tapped at 2 on 4B core #32 |
| *L33,34* | 14 turns on 4B core #32 |
| *L35* | 16 turns #22, 1/4"diameter |
| *L36* | 12 turns #22, 1/4"diameter |
| *1* | AC power cord |
| *1* | 3/8" rubber grommet |
| *1* | SPST switch |
| *1* | fuse holder |
| *1* | 3AG 1/2 amp fuse |
| *1* | 117 VAC primary, 24 volt secondary 100 mA transformer |
| *1* | 1N4001 diode |
| *1* | 320 mfd at 64 vdc electrolytic |
| *1* | 1k, 1/2 watt resistor |
| *1* | 1N4744 diode |
| *1* | 2N5191 power transistor (Q6) |
| *1* | 5 terminal tie point strip |
| *T1,5,6* | 2x5 auto transformer #30 wire on 4B core |
| *T2* | 10 db directional coupler with 75 ohm resistor |
| *T3* | 4 turn center tapped secondary, 2 turn primary on Micrometals 2664000912 core |
| *T4* | 2 turn center tapped on 4B core |
| *1* | LMB chassis box #685 |
| *1* | F81 |
| *1* | 680 ohm, 1/2watt |
| *1* | 1K ohm, 1/4 watt |
| *1* | 6" RG-59/U jumper |
| *2* | 1N914 |
| *1* | SRA-1 double balanced mixer |
| *1* | 12 position, 4 gang switch (S1) |
| *1* | 4 position, single gang switch |

CONTINUED PAGE 48

# CABLE BUREAU COMMUNIQUE

The Federal Communications Commission has taken action in a number of areas which tends to indicate some of the present thinking of the Cable Bureau and the full Commission at this time. Most of these deal with present-day interpretations of the Cable Rules; one, however, gets into the region of MATV regulations.

**A Tacoma, Washington MATV system operator** has been ordered to show cause why he should not cease and desist from further violations of Rule Section 15.31, which pertains to incidental radiation. It appears that the operator of the MATV system in the College Orchard Apartments (A. J. Corvin, Jr.) is picking up the signal of local FM radio station KPLU-FM (Tacoma) on 88.5 MHz, and either purposefully or accidentally **doubling** its frequency so that KPLU-FM ends up on the MATV system on 177 MHz. The MATV system is in turn radiating signal in the area, which allows the 177 MHz signal to interfere with off-the-air reception on channel 7 (locally used in the region). The Commission reports it has "repeatedly given written and oral warnings" to the operator of the system, but to date it has not corrected the problem.

A CATV system to serve the community of **Fridley, Minnesota** has received certification by the Commission for annual franchise fees totaling 5% of the system's gross revenues. The Commission, in approving the excess franchise fee above the normal 3% ceiling, noted "The City of Fridley, as local regulator, has provided a detailed and documented explanation of the costs justifying the (initial) franchise acceptance fee and the reasonableness of five percent". The Commission warned however "we will not sanction excessive fees and will watch for evidence of abuses".

A proposed CATV system for **Washburn, Maine** has received a Certificate of Compliance for an "indefinite period of time" although the franchise the cable operator (TEL-TECH CABLE TV, INC.) has is "yearly" in term. The City of Washburn requires "annual review of the franchise" under which the CATV company operates. The cable company argued successfully that the terms of the franchise are the same, year after year, only the annualized expiration date of the franchise changes as each successive renewal is considered and approved.

The Commission agreed that annual re-submissions for Certificates of Compliance would be an "undue administrative and economic burden" for the CATV operator.

CONTINUED FROM PAGE 47

| | |
|---|---|
| *1* | 117 VAC pilot light |
| *2* | knobs (custom) |
| *1* | master circuit board |
| *1* | oscillator circuit board |
| *1* | 43.25 MHz oscillator (complete module) |
| *1* | 65.25 MHz oscillator (complete module) |
| *1* | 163.25 MHz oscillator (complete module) |
| *14* | 1" spacers |
| *5* | 6:32 x 3/4" screws |
| *13* | 6:32 nuts |
| *4* | right angle brackets |
| *9* | 4:40 x 1/2" screws |
| *9* | 4:40 nuts |
| *3* | 6:32 x 1/4" screws |

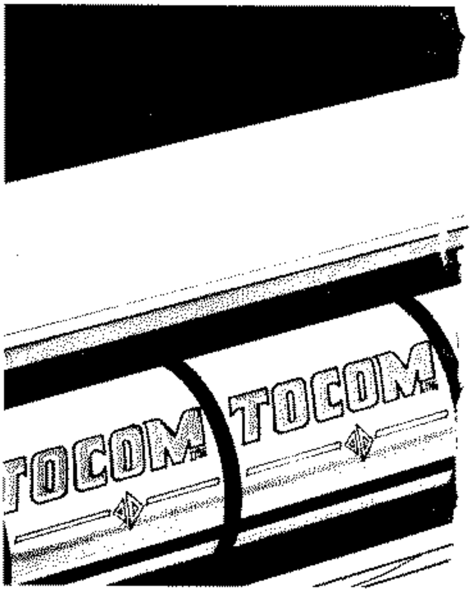
*KIT AVAILABILITY*

*Kit Alone* — complete with all boards, parts, plug-in oscillators, and all parts required for assembly as described here ........ $175.00

*Kit - 2B* — Two circuit boards used in construction (master board and oscillator board less plug in oscillators) .. $25.00

*Wired & Tested* — Mark-A-Channel unit as described herein, wired and tested ........ $300.00

*Note:* To order kits or wired and tested unit, use order card appearing between Pages 8 and 9 of this issue of CATJ. Allow 3 - 4 weeks for delivery of kits, 4 - 5 weeks for delivery of wired — tested unit.

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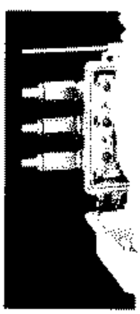

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