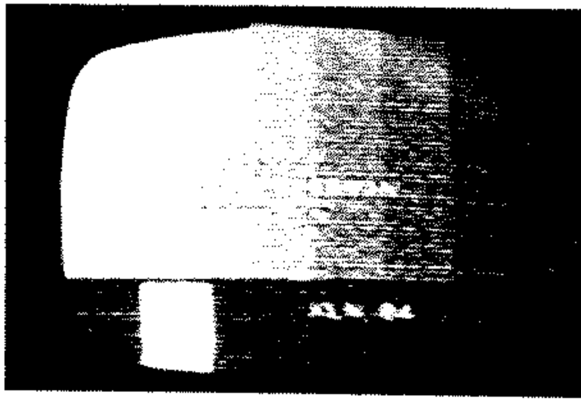
CATJ
SEPT. 1975



Co-Channel Phasing

ATTENUATION

PHASE

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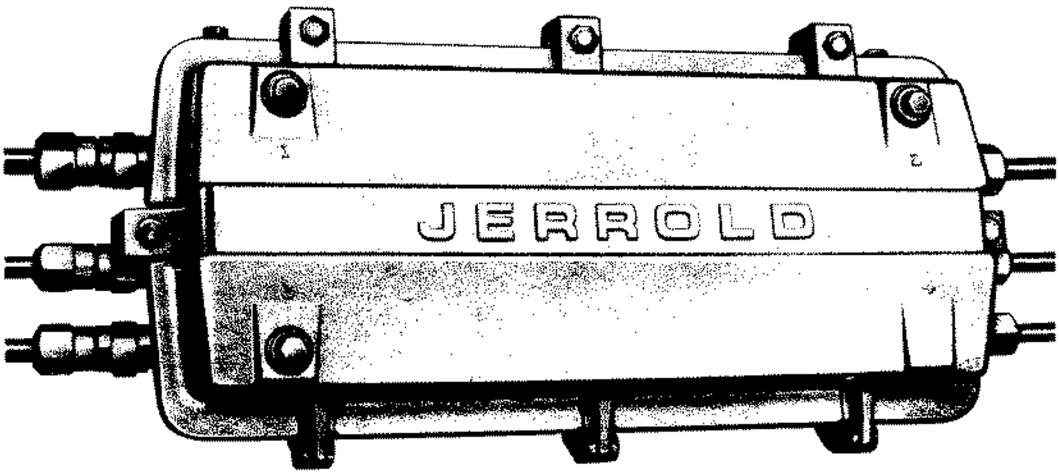

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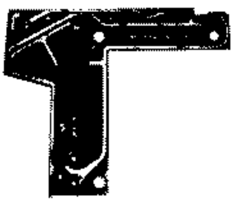
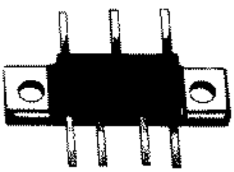


ADAPTIVE POWER CONTROL provides continuous power to CATV distribution amplifiers for interruption-free service to subscribers by automatically adapting to, and compensating for, overvoltages and transients; also protects power supplies and amplifiers from damage and substantially reduces costly maintenance. Patent pending.



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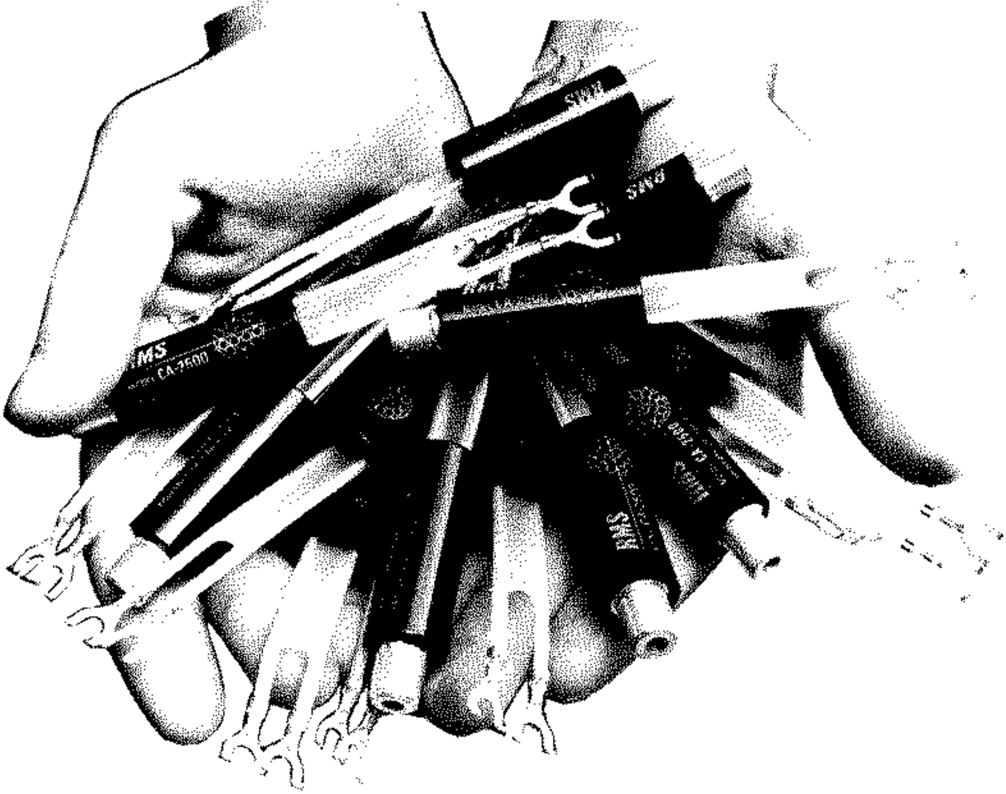

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CATJ

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—CONTENTS—

OUR COVER

Co-channel elimination has been through many "phases and crazes" through the 25 year history of CATV. The latest is 'down-phasing', as our detailed report beginning on page 12 here this month reports. (P.S. — It works!)

CATA -TORIAL

KYLE D. MOORE, President of CATA, Inc.

"R" Is For Rubbish

It is apparent from the trade press that specializes in such things that the pay-cable bandwagon is moving into second gear. The weekly run-down on who has signed up whom to show what, appearing in **CATV WEEKLY,** leads you to the assumption that in spite of the best roadblocks of the FCC, pay-cable is off and running.

A new service, **any new service,** which a cable company can offer to the public at a profit, is worthy of close study. With our monthly off-air service rates virtually frozen by the FCC's rules, and the reluctance of city fathers to authorize us to charge more for the "same old services," **any concept that promises to allow us greater return** on our **existing** cable plant is important.

Still, there is the gnawing feeling in the pit of our stomach that nct everything is going smoothly in the pay-cable world. First of all, we are reminded that nearly ten years ago the industry rushed into the local origination scene. We installed expensive (for CATV) studios, expensive film chains with VTR equipment, and some systems went into local color. The FCC was **so impressed** with our concept that **they made local origination mandatory.** Today the "Equipment For Sale" sections of the trade magazines are all too often filled with local origination equipment which desperate systems are willing to unload at a loss. Most systems (although admittedly **not** all) found out that local origination is expensive, a pain in the you know where, and, more often than not, unable to compete for audiences against broadcast station programming.

Then early in the 70's the industry rushed into the "two-way capability era", and once again the FCC was so impressed that **they made it mandatory** for new systems in major markets. So today we have thousands upon thousands of miles of "two-way capable" amplifier housings; plugging away in the single-way mode because between the blue sky of being capable and the real world of being able we found out there were engineering problems that we could not **afford** to solve.

In both local origination and two-way capability, we let our mouths get in the way of our hands and our brains. **We spoke out when we should have been quiet.** And it has cost us as an industry untold millions of dollars that could have been invested **more profitably** in line extensions or better headends for off-air-signals.

So here we are on the doorstep of pay-cable. **CATV WEEKLY** tells us about systems who have attained 40-50 and even 60% penetration with pay-cable. So what is pay-cable? Basically, it is programming not available from conventional broadcast television stations. In most sections of the country, that amounts to movies, with some sporting events thrown in for good measure in the northeast.

With full respect for the FCC's protectionistic rulings regarding movies, what we end up **being able to show** on pay-cable are movies which broadcasters do not want or cannot touch because of the subject matter and language. Movies are generally rated G (for all audiences), PG (general, but parental guidance suggested for young children), R (for restricted audiences, no children under 17 unless accompanied by an adult) and X. Broadcasters have found that G and PG are their main sources for network movie showings; although a couple of heavily edited R films have made it on the nets.

Cable ends up with **well-worn** G and PG films, and about all of the R material we want. Cable **could also** have X films, but that is a step few if any have yet taken. Now the basic difference between an X and an R film is the **explicit visual** scenes. X films have sufficient **explicit** nudity, **explicit** sexual acts, etc. to make editing almost impossible. By the time you clip the X material, you seldom have anything left but a short subject film with gaping continuity holes. R on the other hand is usually devoid of **explicit** nudity or **explicit** sexual acts (yes, you may see an occasional breast or lots of bed-sheet covered motion, but it is **not explicit**). R films get their ratings primarily because of their **language**. Blazing Saddles, for example, could have easily been a G or GP film **if the language** had been more carefully controlled. The visuals probably would fly alright as the film came from the movie studio.

So here we are with a strong suit of R films on pay-cable. Films that get their shock-value by using **language** not found on Walt Disney. Now, how do we as an industry handle pay-cable? **Many** systems simply set aside channel "R" (or 12, or whatever) for pay-cable, and install a **signal-eliminating trap device** at the subscriber's home. The trap, being a creation of man, has parameters of its own. It functions by trapping out (i.e. eliminating) **the video** on the pay channel. **But the audio,** well, it rides through almost as if the trap were **not** there. Traps are **not** very secure "security devices."

So R films, a staple of pay-cable, **lose** their video but **they retain** their audio. Because that is the only way we can make the inexpensive subscriber traps play.

Now go into a family-oriented home that has elected **not** to take pay-cable. Switch to the pay-cable channel. And listen. Listen first to the **language** of the R rated film, and then listen to the language of the home's parents as they try to explain to their six or seven year olds why **those words** are coming out of their TV set speakers.

Cut now to the cable TV system office and listen to the telephone calls from people **who are offended** by the audio of Blazing Saddles. Listen as they patiently explain that as parents they cannot sit **on top of the family set** 24 hours a day to keep their kids from tuning it in. Listen as they complain that the kids don't understand that they are **not supposed to get that channel,** and that when they switch to the channel and the picture is bad, the kids do what any kid will do; he fiddles with the fine tuning **trying** to make the picture materialize. **And while he fiddles, someone says F....**

We have **no beef** with pay-cable. Many systems **need it** to swim; without it, they may well sink. But we think that as **long as we as an industry** have this technical difficulty, and as **long as pay-cable audio** is going into homes, **we had better be prepared** for that first diluge of letters that FCC Chairman Wiley receives complaining about **our pay-cable language;** language which the family **explicitly did not want** when they said **"no"** to the pay cable offering. This sort of problem could create a "need" for the FCC to step into the "censorship arena" of pay-cable movie programming. Do we want or need that? I think not. Let's find a technical solution to this technical problem...**and fast!**

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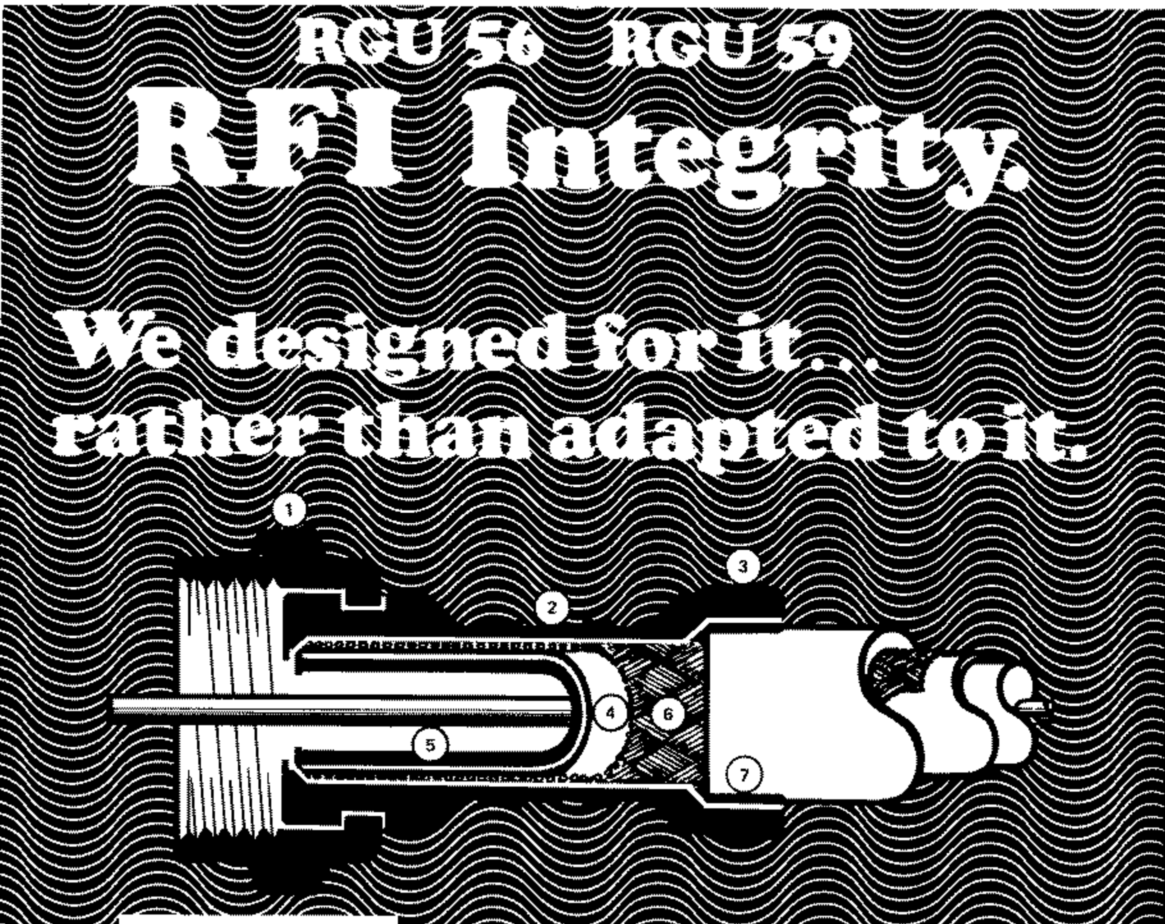
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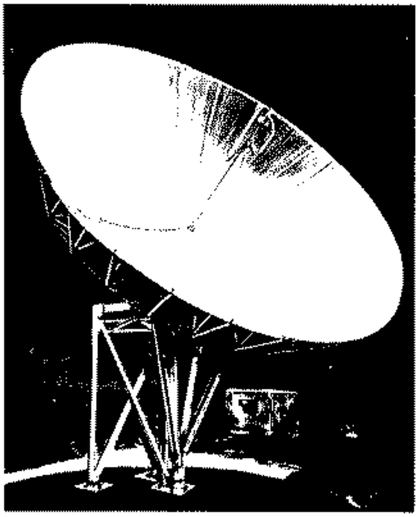

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The earth station consists of an antenna, its associated feed and mount, and a low noise amplifier and receiver, all properly interconnected for optimum system performance. It's extraordinarily simple to operate and maintain, and the construction and installation costs are moderate. Also, it's designed to be completely flexible. Additional features or capabilities can be added as the need arises.

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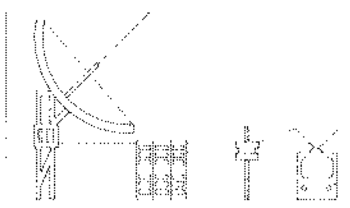

We've prepared a brochure to introduce you to the Scientific Atlanta earth terminal. The sooner you read it, the sooner you can begin planning your future in pay TV. Write for a copy of the brochure, or for more information on our complete distribution and head end systems call Jay Levergood collect at (404) 449-2000.

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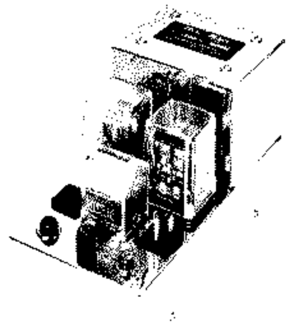

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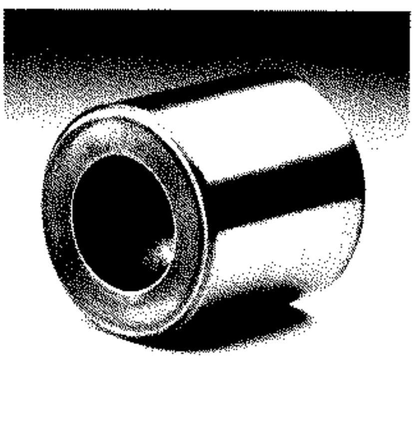

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180 DEGREE PHASE REVERSAL SUGGESTS POSSIBLE CO-CHANNEL ELIMINATION TECHNIQUE

Through the years that CATV systems have been faced with co-channel interference, there have been any number of solutions offered by inventive design engineers. The early days of CATV concentrated co-channel rejection techniques at the antenna; where, as CATJ has previously discussed (1) antenna stacking and phasing systems can be employed to *reduce* or in some fortunate circumstances *eliminate* objectionable co-channel interference. The *antenna-phasing techniques* have endured time, and hundreds of systems still employ them.

Then some years later Dworkin found that if you have baseband video (i.e. the RF signal demodulated to video), the objectionable beat between two carriers could be filtered out using baseband trapping techniques. Several baseband "filter" units for CCI were offered; a couple are apparently still on the market. They work on the theory that CATV beats (i.e. the heterodyne produced between two video carriers) are usually 10 kHz apart (in frequency), or 20 kHz apart. And that the co-channel lines *on the viewer's screen* are really the beat-note (or video counter-part) between the two carriers. Actually, the TV receiver becomes a "mixer" with two carriers, say 10 kHz apart in frequency, being received simultaneously. When the two frequency-offset carriers are demodulated, they "mix" in the demodulator (i.e. detector) and produce a new, third carrier. This third carrier is visible at video as the "difference frequency" between the two RF carriers, and it is a 10, 20 (or 0, give or take transmitter tolerances) beat.

Antenna-phasing techniques are usually reliable, *once properly adjusted,* but adjustment is exceedingly difficult, and very slight movements of the antenna array, even to the point of torquing up on a lug nut, have been known to *de-phase* the carefully adjusted phase-null. So at best, antenna techniques, except perhaps for rear-of-antenna co-channel sources, *are black-magic oriented.* And they get more complex almost as a log function as the *height* of the tower increases.

Video-filtering techniques at baseband, on the other hand, are best characterized as "*conditionally* stable," meaning that they suffer *some* temperature-stability problems. They also suffer from transmitter-drift problems; the *filters* are by design very sharp *traps* that notch out the video

(1) *See June 1974 CATJ*

baseband in the frequency region of the beat (i.e. at 0, 10, or 20 kHz). They *must* be sharp to take out the beat and still *leave* the required video information intact. By being very sharp, they can lose a great deal of their effectiveness by drifting a little bit down or up in frequency, as a function of operating environment temperature, humidity, or both. And, being very sharp, if the offending transmitter and/or the desired transmitter drift (and they *all* do to some extent), the frequency of the beat *between* the two carriers changes. What may be a nominally 9 kHz beat one day could easily be an 11 kHz beat the next day. Not enough move to cause the FCC to move in, or the video co-channel interference beat on the unfiltered screen to change its apparent form to the average eye, but enough to cause the sharp trap/filter pre-adjusted for 9 kHz to lose its hold on the beat-produced "carrier."

So the pot at the end of the co-channel interference rainbow has never really been found. *People still have problems with CCI,* and so consequently inventive engineers are *still trying to solve the problem.*

In the August 1974 issue of *CATJ*, the magazine queried readers as to what their biggest problems were. A very high percentage (over 15%) rated "co-channel interference" as *one* of the top problems; it made the top five problems for the year. So while we may only talk about it in hushed tones and behind closed doors, clearly the industry for all of its other problems (technical *and* political) has still not come to grips with a problem that originated in 1948. *Co-channel is still with us.*

Phase It

Television reception presents unique problems for co-channel interference. The television-reception industry is saddled with AM (amplitude modulation) in the video carrier, and when a carrier is amplitude modulated, we just "ask for" a beat to develop between two carriers that happen to be close in frequency. In AM radio broadcasting, you can "hear" the beat, especially on the high end of the AM band at night (in the 1,200-1,600 kHz range) when "skip" is in. The Mexican stations don't maintain the same transmitter-frequency tolerances we do, *for example*, and when a Mexican on 1548 beats with a U.S. station on 1550, we hear an audible 2 kHz beat note between the two carriers (it sounds like a 2 kHz shrill pitch interposed in with the audio from the 1550 or 1548 kHz station[s]). U.S. and Canadian stations stay close enough to the same nominal AM frequencies (i.e. such as 740 kHz) that the beat, if audible, is a low-frequency rumble, such as 50-100 cycles per second.

FM stations, being FM (frequency) modulated at a rate approximating the modulation product of the music or talk presented, don't present the *same* problem. It is the nature of an FM detector that the *strongest* audio/carrier present captures the discriminator, and *you are not aware* that a second (interfering) station is present until it becomes strong enough (or almost strong enough) to capture the discriminator. Then, as if someone threw a switch, the audio of carrier B captures the discriminator, and the audio of station A is gone.

Television-broadcasting standards in some *other* parts of the world include FM modulation of the video. Consequently, in those areas (much of Europe for example) co-channel interference, *as we know it,* does not exist. Remember that with FM (modulation) the modulation product on the stronger (by signal voltage) carrier is *the one* that "captures" the discriminator; the *other* modulation product (and the carrier) is all but totally ignored *as long as* it is weaker.

Then we have *the offset problem.* Television stations throughout the United States, Canada, and along the border areas of Mexico are assigned *on purpose by the FCC* to operate on frequency offsets. That is, rather than assign *all* channel 2 stations to 55.250000 MHz, the Commission assigns Pittsburgh channel 2 (KDKA) to 55.240(000), Baltimore channel 2 (WMAR) to 55.260(000), and New York channel 2 (WCBS) to 55.250(000). The stations are then 10 or 20 kHz apart (New York is 10 kHz from Pittsburgh and Baltimore, while each of these two is 20 kHz from each other). This is done *on the theory* that if a carrier-beat *must* be produced, the video beat produced between carriers 10 or 20 kHz apart in frequency is *less objectionable to the viewer* than the beat produced between two carriers *nominally* no (0) kHz apart.

All of this has been covered rather extensively previously in *CATJ* (2).

Then there is the *level* problem. A beat (i.e. something objectionable on the TV screen) shows up when a non-desired carrier is as much as 40 dB lower in signal level at the processor/receiver terminals than the desired signal. Minus 40 dB *relative to* the desired signal can be a *long ways down.* Hanging large sensitive receiving-antenna arrays 500 feet above ground, or atop a mountain, is one heck of a good way to pick up *two or more stations per channel,* even if the non-desired stations are down 20-30-or 40 dB from the desired station. In real life, if —20 dBmV produces a marginally acceptable picture from CATV receiving antennas, a —60 dBmV non-desired signal on the same channel produces a *noticeable* beat on the screen. Minus 20 dBmV is 100 microvolts, nothing to write home about. Minus 60 dBmV is 1 microvolt; that is hard to see even on a $12,000 spectrum analyzer! In fact, you can probably *see it quicker* when it is beating against a —20 dBmV desired signal than you can searching for *by itself* in the "noise grass" on a spectrum analyzer, even if it is the only signal on the channel.

0/10/20 kHz CCI

Stations operating on nominally the **same offset** (i.e. usually classified as minus [10], zero, and plus [10]) produce one type of CCI pattern. It varies slightly between receiving situations because stations do not maintain precise frequency control, and the beat pattern displayed by the receiver is dependent upon the **frequency separation** between two (interfering) carriers. Generally, it appears as the first photo shown.

Stations operating on offsets which are nominally **10 kHz separated** produce a different kind of visual beat. Again, this varies somewhat because of exact station operating carrier frequencies, but it generally looks similar to the second photo shown here.

Finally, stations operating with offsets which are nominaly 20 kHz separated have yet another beat appearance. The exact beat appearance may vary slightly from that shown.

Knowing the beat-separation between stations is very important, to insure that the signal you are erecting a sense/test antenna for **is the one** that is **really** causing you the problem. One way to be sure is to have a copy of the **CATJ WTFDA TV STATION GUIDE;** only $6.50 postpaid from **CATJ.**

In other words, the TV receiver (even the $69.95 discount store 9-inch black-and-white portable) *can be* a better co-channel signal finder than a $12,000 S/A.

There have been, from time to time, serious proposals to the FCC from broadcasters. These broadcasters want to *extend* their deep-fringe coverage, and they know that given modern-home deep-fringe receiving antennas (or cable receiving antenna systems plus low noise pre-amps), it is not

(2) *See June 1974 CATJ*

signal level, it is co-channel, that is *eating* into their beyond-B viewing contours. One way, from the broadcaster end, for this problem to be rectified (i.e. co-channel effects to be toned down or eliminated) would be for *all TV stations* on a given channel to operate exactly on the same channel frequency assignment. By exact, we mean 55.250000(000). This is *not possible* as long as each channel (2) transmitter employs its own *local* crystal (controlled) oscillator to derive its operating frequency. Try as the various channel (2) transmitters might, they could never (all) stay on 55.250000(000) *simultaneously* if each continued to independently derive *its own* local oscillator frequency source.

One solution to this problem is a *national* phase-locked frequency standard, derived from a Rubium standard, for example. Then if *all* station crystal oscillators stayed phase-locked to a master *single-source* oscillator, there would be frequency (and phase) coherency all across the nation. What that would accomplish is that while there would *still* be co-channel interference, it would be *more like* the kind experienced with FM broadcasters and receivers; the viewer would *not be aware* of the presence of the second signal or station until it became stronger at the receiver than the one he was watching, whereupon the detector would simply switch to detecting the interfering station's modulation, simply because it was now stronger than the desired station.

But alas, in spite of *some* efforts by *some* broadcasters to even start regionalized frequency-locked operation with their neighbors, the FCC has shown little interest in pushing or adopting the project.

So here we are, with those funny *nominally* 0, 10 kHz and 20 kHz lines running through our pictures every time the weather changes or the "skip" comes in. And the phone rings off the hook as subscribers ask us to "take those lines out of the picture."

Into this scenario enters a fairly new comer in the CATV marketplace: *Microwave Filter Company* of East Syracuse, New York. And for approximately $250, they offer to solve your co-channel problem.

How would they accomplish this? By *phasing* the interfering signal "out of the picture" (pardon the pun) with a magic little grey box.

Funny Cigarettes in East Syracuse

We don't know for a fact, but we suspect that someplace *someone* has accused Glyn Bostick and his crew at Microwave Filter Company of puffing on "funny cigarettes." Anyone who has grown up in the CCI-laden industry knows through trials, tribulations, and tens of hours of antenna pruning that co-channel interference is not solved with funny cigarettes (not unless you can get *everyone in town* to smoke them simultaneously!).

2903 Co-Channel Eliminator

And when *CATJ* asked usually cooperative Mr. Bostick for his assistance in looking at how the industry was *responding* to his model 2903 (series) "co-channel eliminators," we fully expected him to tell us to get lost. Rather he responded by providing us with a file full of letters (some good, some bad) from users and the complete list of everyone who had ever ordered a 2903 "eliminator"; including those who returned the units after a field trial. That kind of openness surprised us. It turned out that Glyn Bostick had nothing to fear from our "prying" and he knew it.

The 2903 series Co-Channel Elimination units are very cleverly designed phasing devices, *not unlike* the fabled "line stretchers" of olden days (remember those Bruno?). Many years ago (more than ten) we got a first-class lesson from Bruno Zirconi at *Scala Radio* in San Leandro about line stretchers. We had a nasty channel 7 co-channel problem, which we had attempted to solve by stacking four channel 7 Yagi-Uda antennas in a horizontal format (i.e. side by side, four wide). We had played and played and played for days moving one antenna, then another antenna, and on and on. Sometimes we had it, then we lost it. Bruno came to our rescue with a coaxial line stretcher, which let us leave the antennas alone, and by cranking on the line stretcher we were able to insert varying amounts of cable (a centimeter at a time) into the phasing lines until we found the right combination to phase out the non-desired signal.

The 2903 series box *starts* from the *same* premise, although creator Bosstick has a different set of parameters in his end "box." We'll find out why and how shortly.

Do As I Say

Our first introduction to the 2903 was with a fellow down in Texas who had ordered one shortly after they were announced. *"How does it work?"* we asked him at the time. *"It doesn't,"* he responded.

So we took a look at what he was doing. The 2903 had been installed in the down line of the desired station antenna array. There are two knobs on the 2903, and naturally any good operator immediately inserts the 2903 in his downline and starts cranking on the two knobs as soon as the unit arrives. Only, as the Texas operator had told us, "it doesn't work." *At least not that way.* Oh, the picture content changes all right as you crank on the knobs. If you crank on the one marked "Attenuation," the picture drops clear out ("now *that* eliminated the CCI," my Texas friend remarked). Not just the non-desired signal, but *both* signals. Then if you bring the Attenuation control back up to full clockwise and crank on the other knob (marked "Phase"), the picture changes content—a little bit. But the CCI and the desired signal change *at the same time.*

"Let's sit down and read the instructions," we suggested to our Texas friend. "The darned thing doesn't work . . . what is there to read?. You just insert the downline into the *In* spigot and loop to the processor out of the other one," he murmured as he walked away. "At least I didn't have to climb the tower to find out it doesn't work," he was heard to utter as he disappeared into the outside world.

So we read the instructions. It turns out that the 2903 was installed improperly. Something we later found was probably true with dozens of *other* 2903 units shipped out by Glyn Bostick, if our followup to his sales list is indicative of what *really happened* out in the field.

It turns out that the unit must (repeat *must*) be installed *according to the instructions.* There are *no* short-course stop-gap approaches. Either you do it right, as shown in Diagram 1, or you don't bother to do it at all. And if you do it right, we found out from several hundred hours of playing (more about that shortly), there is only one way you can fail. That we will also cover.

In Diagram 1, we have the desired station with *its own antenna,* connected to the headend processing equipment through a 6 dB directional coupler. The desired station signal feeds through the directional coupler via the input/output ports (i.e. not through the 6 dB down port).

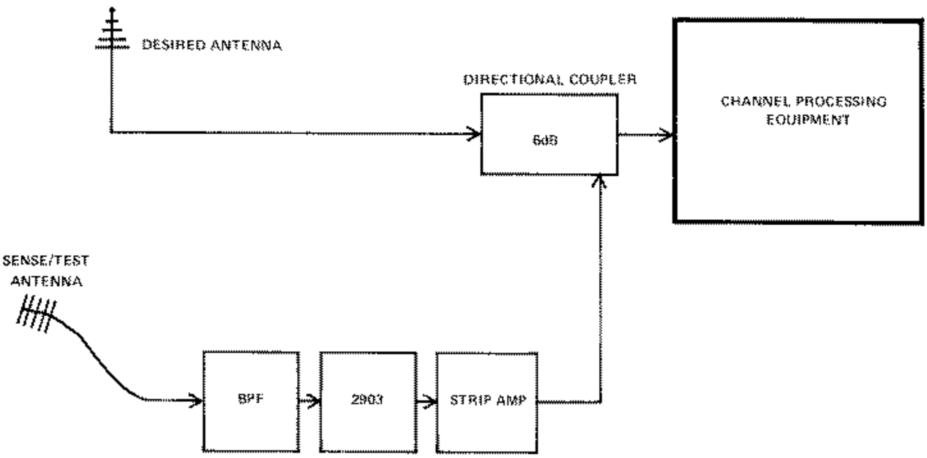


DIAGRAM 1

Then we have a separate, *second* antenna, erected *primarily* to provide signal from the non-desired station. Now this non-desired signal can come from a same-channel source (i.e. true co-channel), *or* it can come from an adjacent channel signal. This non-desired signal, co-channel or adjacent channel, is then fed through a bandpass filter (something to clean up off-frequency signals) and then through a 2903 (2903-2/6 is tuneable for channels 2-6; 2903-7/13 is tuneable for channels 7-13. UHF models are also available.). Then, if required, the non-desired signal goes through an amplifier (that's right . . . *an amplifier*) and into the 6 dB directional coupler, through the 6 dB port.

The equipment on the *desired* station is just as you *now* have installed; plus, the addition of the 6 dB directional coupler.

The equipment on the non-desired station breaks down this way. The antenna is to pick up the non-desired signal. The bandpass filter is to ensure that you end up going into the subsequent amplifier and directional coupler with primarily just the channel you wish to trap or phase out. We found that you could eliminate the bandpass filter *if* you put a good high-selectivity single-channel strip amplifier (a B-T unit with*out* mating bandpass filters is NOT adequate) at the amplifier position. The 2903 is the *magic* box.

The 2903 deliberately seeks out a *sample* of the non-desired signal. On its own antenna yet. Then through the 2903 the non-desired signal is inserted into the line with the desired signal, after reversing the phase of the non-desired signal. That is pretty simple, and that is the way it works. You must have a level of *non*-desired signal through the "sense" antenna that is at least compatible in level with the *same non-desired* signal coming down the downline *with the desired signal.* If your desired station antenna is picking up 50 microvolts *of non-desired signal,* you really need to be in the same general ballpark with the non-desired signal *through the "sense" antenna* arrangement, if you want the phase cancellation to work.

With the installation rigged up as shown (again, follow the directions, and the only valid *substitution* we suggest is elimination of the external BPF *if* you have a first-class highly selective *on-channel* [*not* heterodyne] processor), you adjust as follows:

(1) Place ATTENUATOR knob fully clockwise (minimum attenuation);

(2) Rotate PHASE knob for greatest *erasure* of the co-channel interference (the point of erasure will be *fairly* broad usually, meaning that you don't have to sit there and breathe on the knob a little at a time);

(3) Rotate ATTENUATOR knob counter-clockwise for the point of best (usually total) erasure of the CCI or adjacent signal;

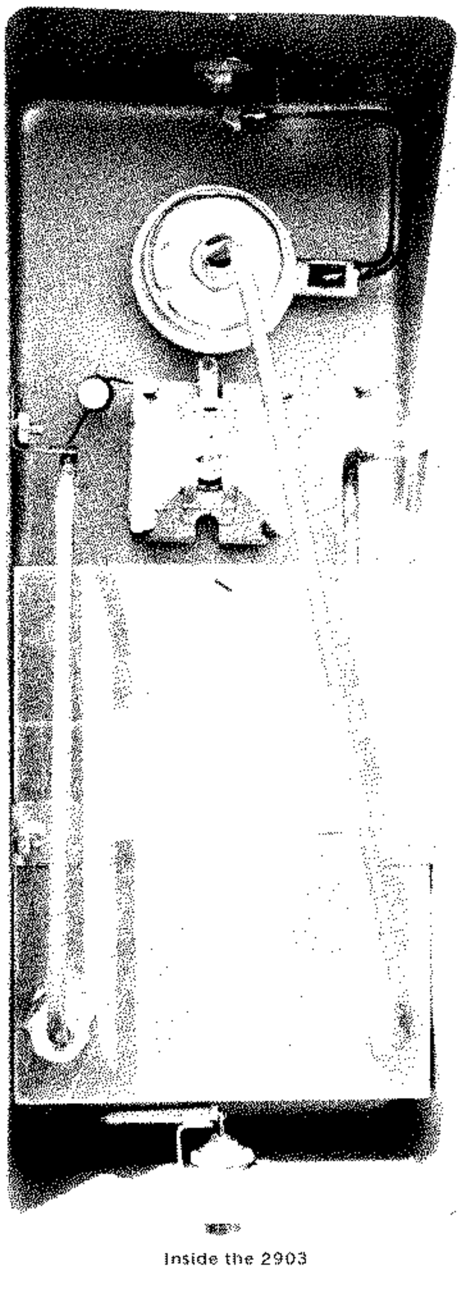
Note: If it turns out that your *best point* of CCI erasure with the ATTENUATOR knob is fully CLOCKWISE (i.e. *against* the knob stop), then you immediately know that your sense antenna signal is *not strong enough.* Correct that before continuing.

Then you go back and refine the phasing by touching up the ATTENUATOR and PHASE knobs. *That is about all there is to it.*

Natural Tendency

If the operator gets by *the quickie-desire* to insert the 2903 into the downline of his desired signal (first impulse fresh out of the box; *wrong!*) and decides that he has to go to some (small) effort *to find out if it works*, the next "quickie-stop" is to rotate the *search* antenna toward the non-desired signal and *using it* as a "sense" antenna, insert the 2903 without amplifier or bandpass filter into the lash-up "more or less" as shown in Diagram 1. This is really not recommended; you probably *won't have sufficient signal* on the search antenna to do the job, and while you may get *some* erasure, you probably will find that the ATTENUATOR knob is showing *best* erasure with the knob *fully clockwise*. Remember what the *note* previously quoted said: "If the ATTENUATOR knob shows best erasure when it is fully clockwise, you don't have enough sense signal." *Believe it.*

At some point a little *trust* has to



Inside the 2903

creep in, and in addition to being so benevolent as agreeing to "try" the 2903 from Microwave Filter to "see if it works," you are also going to have to commit to getting together some semblance of equipment to follow the instructions in Diagram 1 and here.

Everyone has a right to be skeptical. So let's deal with those situations which *CATJ* research revealed *do come up* where the 2903 plus the recommended installation will not cut the mustard. There *are* a couple of situations like this.

(1) *Too-close heading*—When the non-desired signal gets too close in receiving-angle to the desired signal, you end up "down-phasing" the desired signal right along with the non-desired signal. Microwave Filter advises that a *ten-degree angular separation* between signals is about as *close* as you can get and still keep the desired signal from being too "hot" on the "sense antenna." In our experience, ten degrees *may be too close*. It all depends upon the type of antenna array you are willing to install for your *sense* antenna. If you horizontally stack a couple of Logs or Yagi-Uda antennas and *space them* so that they *antenna*-phase-null toward the desired signal (i.e. purposefully go after the *non-desired* signal), you *might* get down to 15 degrees *if* you are careful. There is *one* exception to this rule which we will cover later.

(2) If you are going after the *adjacent channel* (rather than co-channel) with the 2903, the bandpass filter and amplifier sandwiching the 2903 must be for *the adjacent channel* (think about it; it *will* all make sense in a minute).

(3) If the test (sense) antenna and the desired channel antenna array are physically *close* together, there can be *coupling* between the two antennas. That is, the big monster array for the desired channel couples (radiates through the air or re-radiates) the desired signal *into the sense* or test antenna. This results in *too much desired signal*, on the sense or test antenna. We found out that antennas plus or minus 50 feet in height but separated by as much as 200 feet *horizontally* (on adjacent towers) *couple between antennas* much more than we had ever previously suspected. In our *CATJ* test environment, rotating a tower-top search antenna on one tower 200 feet from another tower-top-mounted search antenna destroyed phase adjustments on the 2903. *We got the erasure back* by readjusting the knobs on the 2903 however.
This tells us that if you go through the proper exercise of hanging a separate sense or test antenna, that *before* you button everything up, rotate your own *search* antenna, even if it is *not* connected to anything in this system, and watch the erasure level on a monitor. You *may* have to warn personnel that rotating the search antenna affects the sense-antenna levels and that readjustment of the 2903 system is necessary *after* playing with the search.

This also tells us that if you do some tower work and move some antennas around—even antennas *not part of this system* or not close to the system antennas—you had better recheck adjustments of the 2903 before walking away from the headend.

In words of a few syllables, *phase is tricky stuff!*

One of the popular *misconceptions* about the 2903 type of system is that the adjustments you make are *only good* for the levels being experienced by the sense/test and desired signal antennas *for that moment.* Stop and think about what it is you are really doing. The input level from the non-desired can go *way up* (up to the *point* where it is stronger on the desired antenna *than the desired signal*) and way down (down to the point where you no longer have sufficient gain in the 2903 system to function properly), and the co-channel (or adjacent channel erasure) is *not* affected. *It is not level* which is bucking out the non-desired signal, *it is phase.*

Can the 2903 go *outside?* A better question is *why would you want to put the 2903 outside?* Re-look at Diagram 1.

2903 Specs

Models—
- 2903-2/6 ..... Tuneable channels 2-6
- 2903-7/13 .... Tuneable channels 7-13
- 2903-UL ... Tuneable channels 14-48
- 2903-UH ... Tuneable channels 49-83

Size .... 3.12 x 3.62 x 9.12"
Impedance .... 75 ohms, in/out
Phase Range .... 180 degrees (min)
Attenuation Range .. 40 dB (min)

Price—
- VHF Models............... $245.00
- UHF Models $290.00

Delivery—
- VHF Models .... 1 week
- UHF Models .... 2 weeks

Manufacturer—
Microwave Filter Company, Inc.
6743 Kinne Street, E. Syracuse, N.Y. 13057
(315 / 437-4529)

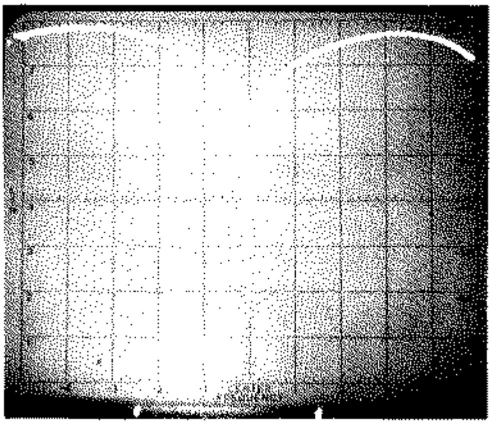
There are two knobs on the 2903. How often do you have to readjust them? *We don't honestly know.* We do know that it is *not* very often. It will depend upon your own headend environment and one other factor over which you have no control. If your headend is reasonably temperature constant, we see no reason (and found no sign) for instability. Neither does Microwave Filter Company; and they say so in their literature.

There is one thing *that will foul you up,* but it may not happen nearly as often as *some* might have you believe. Under strong signal conditions (i.e. when the *non-desired* signal comes *way up* in level), the phase of the non-desired as it approaches your desired signal *and* sense/test antennas *may change;* change *relative to* what it was the day you set the whole thing up and walked away. If *that* happens, *then* you will need to re-tweek the PHASE knob on the 2903. And, *when* signals *go back down* to their normal levels, you will have to return to the headend and re-tweek it back to where it was when conditions were more normal. But, as we noted, *in two months of trying,* under some widely varying signal conditions, we only found this to happen *once,* and then we were *not* totally certain that is what happened.

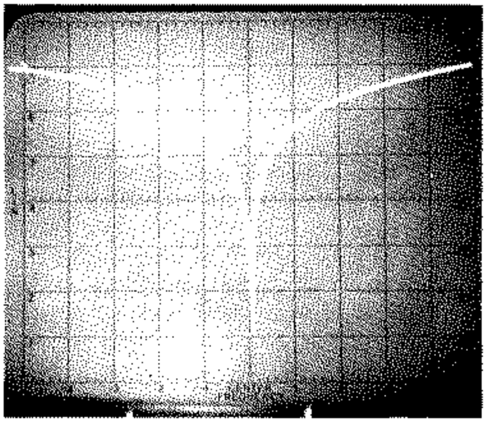
Users Speak

To put together this report (and we are grateful to several systems who provided us with data to add to our own two months of testing), we went to Glyn Bostick's user list. Here is some of what we learned:

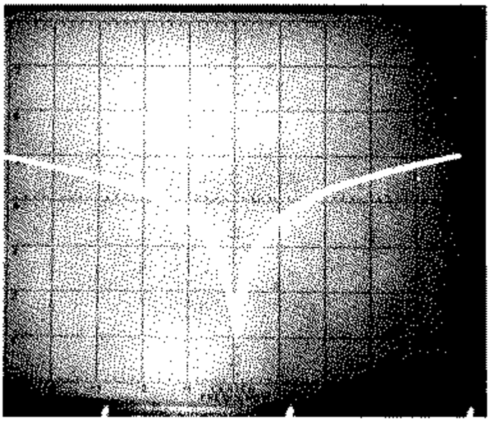
(1) *Howard Lewis, Winchester CATV, Winchester/Lexington, Va.*— "We have four off-air ghosts on a channel 10 signal at Lexington. The ghosts vary in level with the weather and are not always bad. We installed the 2903 and found that we could eliminate one



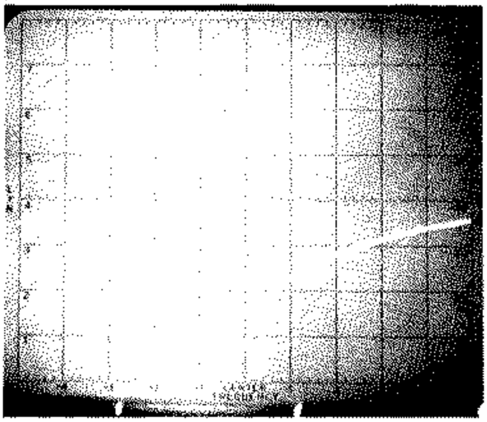
I. Switzer Tests — Cf 100 MHz, vertical scale 10 dB per division, horizontal scale 5 MHz per division



I. Switzer — same vertical scale, horizontal 1 MHz per division



I. Switzer — same vertical scale, horizontal 100 kHz per division



I. Switzer — same vertical scale, horizontal 20 kHz per division

of the two serious trailing-edge ghosts *completely.* It just went away. The non-desired ghost signal path eliminated was approximately 35 degrees off of the desired signal path. But we could *not* solve the main objectionable ghost with our present antennas; it appears to be approximately *10 degrees off* of the desired signal heading. We were about to send the unit back until we experienced a day of severe co-channel from a channel 10 station down in North Carolina. We put the 2903 on the search antenna, rotated the search onto the North Carolina offending signal, and adjusted the 2903. *The CCI went completely away* on our cable signal. That convinced us; we kept the 2903."

Howard also advised that he is working with Lindsay to design an exceedingly narrow beamwidth antenna system to try to chop out the non-desired 10-degree off-main-path ghost signal.

(2) *I. Switzer, Switzer Engineering Services, Mississauga, Ontario*—"We ran some tests on the 2903, setting it up as a notch reject filter, using our H-P tracking generator/spectrum analyzer. It appears that 65 dB of attenuation is possible over a *very narrow* bandwidth. Our application is for rejecting a strong undesired adjacent-channel *FM signal.* FM deviation runs to +/— 75 kHz, and we were concerned about the rejection over the 240 MHz or so of occupied spectrum. It looks like we should be able to get

about 40 dB of rejection. Our next concern is stability with time and environment."

"What is really needed is a phase-lock loop of some kind to maintain maximum cancellation. It requires automatic electronic phase-and-attenuation control. Our past experience with 'bucking' systems like this (we used to use step attenuators and General Radio line stretchers) is that they need to be adjusted everyday."

(3) *Robert E. Johnson, Georgetown Cable TV, Georgetown, Ky.*—"We made the usual mistake, and after installing the 2903-U/L (*Editor's note*—UHF version for channels 14-48), we had no results. After thinking it over, we reread the instructions and did it again."

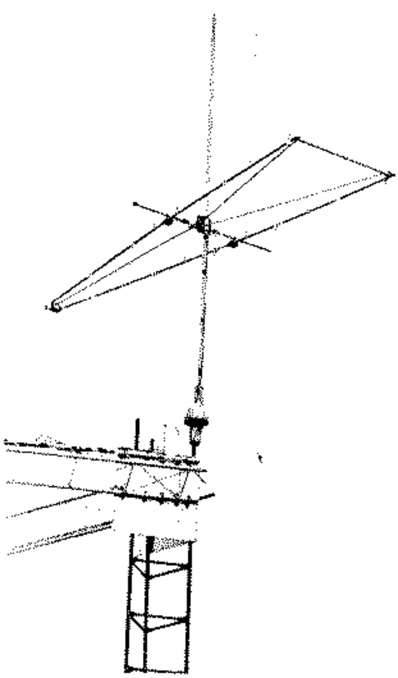
"The 2903 is now doing a beautiful job and has completely solved our problem in eliminating adjacent-channel interference. We are only 10 miles from channel 18, and we needed to receive a very desirable channel 19 about 60 miles distant. We were about to enter into a very expensive trial-and-error antenna-phasing project recommended by another equipment supplier. Best of all, the 2903 puts the 'controls' in the headend, in the hands of the system personnel, not out on the tower at the mercy of the elements."

Forms of Interference

During the summer months, many systems (read *majority*) experience co-channel interference on low-band channels during periods of something affectionately known as "Sporadic-E skip" transmission (see *CATJ* for October 1974). Sporadic-E skip is a transmission mode via the E layer of the ionosphere wherein a *distant* signal (up to 1,500 miles away is not uncommon) arrives at your headend via the E layer. The signal literally "skips" hundreds of miles and ends up to do you in for a few minutes or a few hours at a time. In some sections of the country it is so frequent in the summertime that stations such as WESH (channel 2) in Daytona Beach, Florida have special station-break ID slides they put up which tell the local viewers *"Sorry for the interference—it is not us; it is due to atmospheric conditions."*

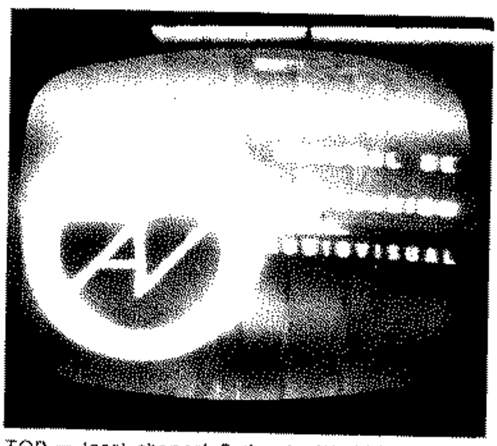
During this past summer here at the *CATJ* lab, we experimented with the 2903 and some *known-to-us* characteristics concerning Sporadic-E. For example, very *often* the wave-front polarization of the Sporadic-E propagated signal arrives at a distant point no longer bearing *its original horizontal polarization.* The polarization is skewed or twisted during the "skip" process and ends up being received in a vertical plane stronger than in its original horizontal plane.

Which gave us an idea. We took an MATV-type low-band log antenna, redrilled the holes in the boom, and hung



Vertical test/sense (Log) antenna installed for tests it up so that it was *vertically polarized.* That means it was now most responsive to the vertically polarized signal.

Then we used it for a *sense* antenna, through an amplifier etc. as shown in Diagram 1, and when the skip rolled in (this was *not* a bad summer for skip as summers go), we rotated the vertically mounted low-band log toward the non-desired skip station, and fed it back through the 2903 system and into our 6 dB coupler. It worked very well, so well that station XHGC in Mexico City, which is within a few degrees (read *less* than the magic number ten), as received on the vertical-sense antenna, could be totally phased out (i.e. *erased* as Glyn Bostick would say). That worked so well we decided to *reverse* the antennas; we hooked the *vertical* log to the *desired* antenna-input port on our channel 5 processor (through the 6 dB directional coupler) and put our *normal* channel 5 antenna through as the *sense* antenna. Now our channel 5 is all of 15 miles away (south), and it runs + 25 dBmV off our permanent channel 5 antenna. Yet as the photo here shows, we were able to take that +25 dBmV *local channel 5 signal* and run it almost totally *out* of the picture, bringing the Mexico City station *right in over the local signal.* That doesn't have many *practical* applications for



TOP — local channel 5 signal with 2903 adjusted for elimination of XHGC co-channel
BOTTOM — XHGC signal riding "through" local channel 5, with 2903 adjusted for elimination of local signal

TOP — local channel 5 signal with 2903 adjusted for elimination of Mobile (Alabama) channel 5
BOTTOM — Mobile channel 5 through local channel 5

the CATV system that doesn't have a CAC for Mexico City signals. But it was an interesting experiment in phasing for the hour or so that the E skip condition lasted!

Just to prove that this was no never-to-be-repeated fluke, we set up again one day in late June and repeated the experiment using our local channel 5 and a skip signal from WKRG, channel 5 in Mobile, Alabama. As the two photos show, we could get almost perfect pictures on *both*, local channel 5 and WKRG, *at the same time* using two separate receivers and a doubled-up 2903 setup. Again, not very practical *. . . or is it?*

Late in the summer of our 2903 tests, we set up to see if a person could simultaneously pick off *and use* two *same-channel* signals. Our test channel was 7, because we happened to have a couple of channel 7 signals to "play with." We went through the procedure of setting up as per Diagram 1 *double installations* on channel 7. We were after simultaneous use of station KOAM in Pittsburg, Kansas and KSWO in Lawton, Oklahoma. Now where we are located, neither signal looks *first class* all of the time (we are well beyond B for KOAM and far enough out for KSWO that it drops into snow every now and again). But then we have no CAC for what we are doing anyhow, so our pictures can get a little cruddy now

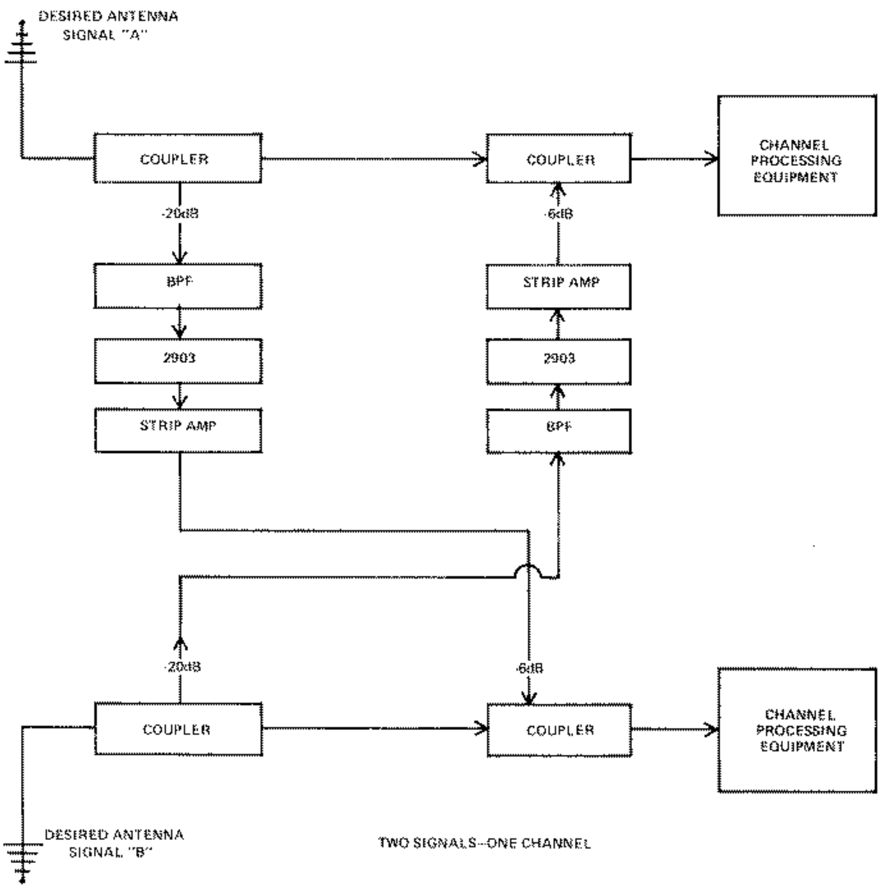


DIAGRAM 2

and then. (We should be *quick* to point out that we have *fewer* than 50 customers at our *CATJ* test-site system also!)

Everything worked out just fine, we are happy to report, except that we experienced a fair amount of *antenna coupling*. With *four* separate channel 7 arrays on the towers, no wonder. With one each sense/test *and* stacked log array on both KOAM and KSWO, we were probably asking for trouble to begin with. Then it occurred to us that *if* we were stacking logs for desired-signal reception of both channel 7 signals, why not *sample each* through a directional coupler and simply *do away with the separate pair of (extra) sense antennas*. We did this per Diagram 2, and are able to report that our previous coupling problems disappeared. If you decide to use *two stations on the same channel*, this *may* be your answer.

Conclusion

Normally, in an equipment review, which this resembles *in a small way*, we go into the mysteries of the box being reviewed and talk about its construction. We won't do that here. We are showing you a few pictures of the 2903 innards, however, with the warning that you probably cannot duplicate one on your own unless you have infinite patience. There *are* a couple of *tricky* things inside of the container!

Part Three Of Three

CATV ANTENNA BASICS

The Log-Periodic dipole array (LPDA) is (unlike the Yagi-Uda) an antenna with many known, precise mathematical parameters. In fact, the LPDA was, we are told, derived on paper with formulae and developed well through to its final form long before the first real-life (model) antenna was constructed.

In our Part Two of this series (July CATJ), we ended our brief visit with the Yagi-Uda by noting that the LPDA was developed as "an offshoot" of the Yagi-Uda. In a sense this is true, although there are virtually no *operating* similarities between the two.

A Yagi-Uda-design antenna can be made to cover a (relatively speaking) wide band of frequencies *if* you treat all (or most) of the elements as active (dipole) elements. Diagram 1 illustrates. Rather than the traditional reflector, dipole, and director elements, each so stagger-tuned as to be resonant over a fairly narrow band of frequencies, a Yagi-Uda-type design substituting active (dipole) type elements for all directors can be built. In fact, during the 60's a semi-popular home antenna was the "Traveling Wave antenna," of similar design.

In this approach, dipole one can be resonant on channel 6 sound, dipole two on channel 6 video, dipole three on channel 5 sound, and so on all the way back to channel 2. Behind the last dipole, a parasitic reflector of the normal length for channel 2 is mounted. In this situation, the dipole elements in front of the two channel 2 dipole elements tend to function as directors (being shorter than is required for resonance on channel 2). However, only the dipole *immediately* in front of the two channel 2 resonant dipoles is actually close enough to the required channel 2 director length to function as a *true* director; so the antenna in the best case becomes a four-element Yagi-Uda equivalent. That is, one reflector, two dipole elements, and a director. In this particular approach (Diagram 1), we have a *four*-element antenna on channel 2 only by virtue of adding the parasitic reflector behind the last dipole element (on channel 2 video). On the other end of the antenna, there is no designed-in *director* for channel 6 (i.e. no shorter dipole in front of the 6 aural dipole), so the antenna is, in our example, a three-element equivalent for channel 6.

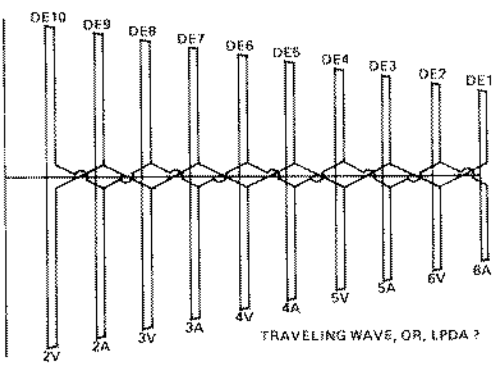


DIAGRAM 1

The Traveling Wave antenna enjoyed something other than widespread acceptance when it was on the home-antenna scene, but *it was an attempt* to satisfy the need for wide-spectrum directive antennas with gain and front-to-back (front-to-side) ratios similar to a Yagi-Uda antenna. And it came directly out of the original Yagi-Uda design.

The LPDA antenna took over where the Traveling Wave antenna left off. Only it began from a plateau of technology that was more than twenty years advanced from the point where the last prior major breakthrough in antenna technology had left off (the Yagi-Uda in the late 30's).

The LPDA is commonly an antenna of total active elements; that is, every element on the antenna is active in the same sense that a dipole is active (i.e. tied to the transmission line). The most common LPDA antenna designs cover fairly wide excursions in frequency (commonly measured as ratios such as 2 to 1, using the lowest resonant frequency of the design as the starting point). A 2 to 1 coverage ratio LPDA, with a low-end resonant frequency of 54 MHz, would be equally "usable at 2X-54 MHz, or 108 MHz. The wide frequency coverage of the Log has been so widely touted that most people automatically think of multiple-channel coverage (in CATV) when the Log is mentioned. More about that shortly.

In *any* multiple-element antenna, the bandwidth of the antenna frequency coverage is determined by the operating frequencies where the antenna match (VSWR), gain, or front-to-back ratio (or all three) become less than satisfactory for your intended use. A channel 2 Yagi-Uda antenna may seek to maintain a VSWR 2:1 or better (at a VSWR of 2:1, approximately 33% of the induced antenna voltage is lost) with respect to the impedance of the transmission line. But if the same antenna VSWR (i.e. match) rises to 4:1 on channel 3, then fully 60% of all antenna-induced voltage on channel 3 is lost in the "match transfer" to the transmission line. *Additionally,* the channel 2 dipole element on channel 3 is no longer resonant, so the amount of signal voltage *induced into the dipole* element itself is considerably lower than it would be with a channel 3 dipole element (along with channel 3 reflector and directors).

So in actuality, antennas fall out of useful service primarily because they no longer provide useful amounts of induced signal voltage. And most often, this is due to the mis-match created between the antenna active element(s) and the transmission line; and with lower induced antenna voltages due to non-resonance of the elements themselves.

The LPDA addresses itself *primarily* to these two considerations; that is, it seeks to overcome match problems (i.e. mismatch) and resonance normally associated with off-frequency operation of the Yagi-Uda array.

In Diagram 2 we have the symbolic representation of the LPDA antenna. In *this* representation of the LPDA (Log), the individual elements on opposing sides of the center (dashed line) of the array are being fed 180 degrees *out of phase* with one another. More about that shortly.

Basically, the LPDA (log) consists of a number of different "dipole" elements spaced along a (fairly) parallel plane. The element lengths, and the spacing between the consecutive dipole elements increases from front of antenna to back of antenna so that as we move from front (shorter elements) to rear (longer elements) the respective elements cover a wide span of spectrum. The function of each element changes as the frequency changes.

Or to put it another way, if the middle of the antenna elements (DE4A/B and DE3A/B) are "resonant" on channel 4 as "dipoles," then element DE2A/B *acts as a director* and element DE5A/B acts as a (parasitic) reflector. *So far* that seems *not* dis-similar to a Traveling Wave-type antenna.

Note if you will that in our graphic portrayal (Diagram 2) the individual half-dipoles (i.e. DE3A and DE3B are individually *half*-dipole elements) are connected to the "transmission line" through 180-degree phase shift networks. They are alternately fed on opposing sides of a "balanced" transmission line.

A distributive type of feeder system is used to inter-connect the individual elements. It just happens that our feed system in the LPDA is *not* a piece of wire (or pieces of wire), as we find in other balanced antennas (example: Traveling Wave antenna in Diagram 1). Rather, the coaxial transmission line *to the antenna* from the CATV receiving equipment is transformed to a balanced transmission *system* through a matching system, and the *twin booms* of the LPDA *become extensions of the transmission line* (after matching transformation to a balanced condition). Thus the LPDA "booms"

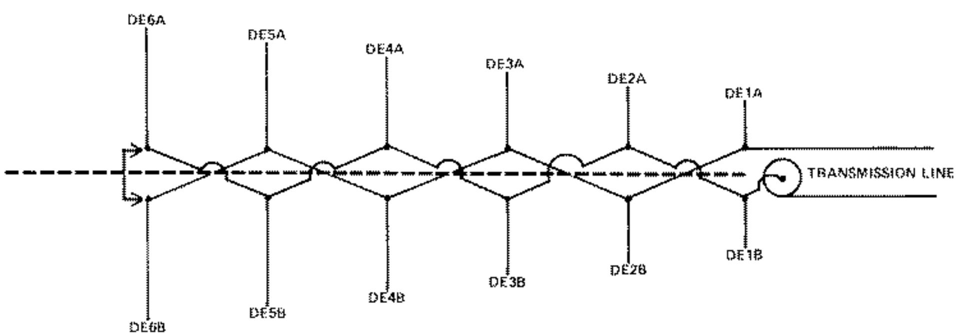


DIAGRAM 2

(there are always two in CATV-type logs) are *more* than mere element supports; *they also carry signal voltages* from the elements to the unbalanced CATV down line.

Returning now to our Diagram 2 illustration, we have a network of "balanced-feed-dipoles,"; each dipole exhibiting differing resonant conditions (i.e. length) for a particular (i.e. specific) frequency. In our example, elements DE4A/B and DE3A/B come closest to being resonant on channel 4. Consequently, signal voltage intercepted by these elements finds a largely resistive (i.e. matched) load present at these elements. At the same time, the natural (by design) resonance of element DE2A/B is *more capacitive* (than resistive), and consequently *these dipole elements* function as *directors* (the same thing is true with Yagi-Uda directors, being largely capacitive in function on the actual resonant operating frequency represented by the dipole element). And element DE5A/B is, by being *longer* in length than the required dipole resonant length, *largely inductive.* This causes the element(s) to function as reflectors (again, the same is true with Yagi-Uda antennas; reflectors are largely inductive *at the resonant frequency* because of their off-resonant condition that is on the physically-longer than resonance side of the ledger).

LPDA theorists speak in terms of "imaginary" and "real" currents flowing in the elements, on any given or particular frequency. *Real currents* flow in the resonant elements (and hence down the balanced-transmission-line booms to the downline), while *imaginary currents* "flow" in the reactive (i.e. non-resonant) portions of the antenna. The reactive (non-resonant in terms of real current) elements are generally regarded, as just noted, to be reactive on the *capacitive* side of the ledger *when the elements are shorter* than required for resonance.

The reactive elements induce small voltages, or virtually none at all. They contribute so little, or nothing, to the *real current flow* from the resonant elements that they can be ignored for all practical purposes—*except as they function either as reflector or director elements.*

The LPDA is *frequency independent* (by design) because the important design (and operating) parameters *vary periodically with the logarithm of the frequency.* The average resistance level (i.e. load impedance of the boom-transmission-line), the characteristic impedance of the booms and the so-called admittance impedance (at transmission connection point) of the antenna vary as a function of the logarithm of the frequency.

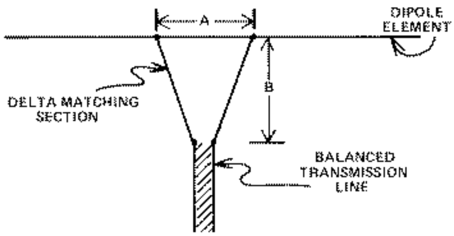


DIAGRAM 3

Thus *the booms themselves* play a very important part in the successful operation of the antenna. They are (1) required to hold in position the dipole elements, (2) serve as "transmission lines" (balanced) to conduct dipole-induced signal voltages to the downline, and (3) by design they have a "taper" (i.e. the boom-to-boom spacing), which forms a logarithm *matching network.*

An example of the latter function is found in the long-utilized delta matching system employed in matching Yagi-Uda (balanced-dipole) type antennas to higher impedance balanced transmission lines. See Diagram 3. The delta match represents a type of impedance transformation network which "tapers" the effective impedance of the transmission line. In this case, the impedance is largest at the transmission line attachment end (bottom) but is lower and lower as the line tapers progressively toward the "dipole element." The two (balanced) sides of the tapered line are attached to points on the single-element dipole which are equidistant from the center (boom-attachment point) of the dipole, and if properly adjusted the load presented to the balanced transmission line is *purely resistive at the resonant frequency.* However, in practical antenna applications, the impedance is other than matched *either side* of the resonant point.

Now refer to Diagram 4. If rather than one dipole element the designer attached multiple dipole elements to a tapered (delta match) transmission network, and if the point of attachment for each dipole was at the resonant point along the tapered-delta for that particular frequency of operation, an LPDA (logarithm) antenna would result.

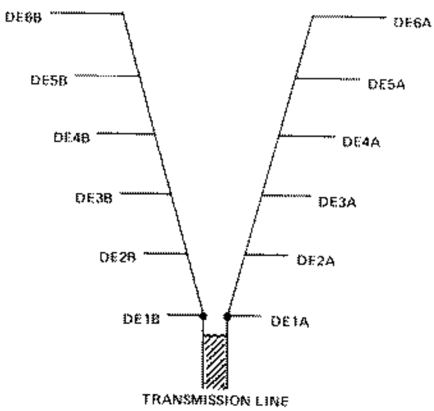


DIAGRAM 4

Many (although not all) logs have an evident (i.e. noticeable to the eye) *taper* between the booms. This is especially true for log antennas that attempt to cover *wide* frequency excursions (such as low- *and* high-band VHF TV). The amount of taper, or the degree of "fan" required for the "delta," depends almost exclusively on the intended frequency coverage for the LPDA; the wider the frequency range, the greater the "fanning" required to maintain a *resonant taper* over the spectrum.

Front-To-Back Ratio

The LPDA antenna has considerably superior off-heading rejection characteristics, as compared with a Yagi-Uda. In other words, the LPDA tends to do a better job *rejecting* (or not responding to) rear and true-off-side signals than a Yagi-Uda. This is primarily because of the active-resonant / non-resonant — non-active relationship which exists with LPDA dipole elements. In a Yagi-Uda antenna, off-side of main lobe signals (including rear of antenna signals) typically *find a way* to the one (or two) active or dipole elements *through reflection paths from the director parasitic elements.* Recall that every time we add a director (or change the reflector configuration) on a Yagi-Uda, we make significant (or at least *measurable*) changes in the directivity pattern of the basic antenna. Directors placed in front of a dipole element are basically phase-coherency devices. That is, they are located along the boom of the antenna, ahead of the dipole element(s) in such positions as to phase-reinforce the desired signal at the dipole element. But phase is a fickle task master, and what is in-phase for one (forward direction) desired signal may often be out of phase for another (side or rear) non-desired signal. Which is another way of saying that with a Yagi-Uda design, when you place directors (and reflectors) around and about the dipole element, you are attempting to get everything in-phase *in the desired direction;* and, well, *if* you end up with everything *out of phase* (i.e. signal *cancellation*) for *non*-desired direction signals; *so much the better.* Unfortunately, you seldom if ever do both *simultaneously.* That is why a plot of a Yagi-Uda antenna pattern has so many side (or minor) lobes distributed through the side and rear portion of the pattern, as at various headings the phase relationships change to either add or cancel (i.e. accept or reject) signals in those directions.

The LPDA, with all of the elements active (on their respective frequencies), has only minimal pattern distortion from non-resonant elements (i.e. those where *imaginary* current flows). Because every element is connected directly to the transmission feeder (the active boom), there is very little opportunity for free-space (inter-element) phasing to occur.

Thus the LPDA exhibits superior rejection characteristics; it has better front-to-back ratios and front-to-side ratios (on the average) than comparable Yagi-Uda antennas. The front-to-back ratio of the LPDA can also be improved in some circumstances by shorting the rear of the booms together. If this is done when the longest (last) dipole elements are mounted *at the end* of the booms, the *longest* elements become typical parasitic-type reflectors (i.e. they are no longer part of the dipole chain). However, many LPDA designs extend the booms backwards *beyond* the last active dipoles by as much as 0.25 wavelength on the lowest frequency; and either short the booms together at that point or mount a set of parasitic reflectors. Practical field experience indicates that this may result in a 2-4 dB additional *front-to-back ratio.* The same thing can be accomplished by simply designing the frequency coverage of the LPDA to extend lower in frequency than the actual *intended* frequency range, wherein the lowest frequency resonant dipole element is a reflector in disguise in the *actual* operating frequency area.

Not Always Broadband

Most of our discussions thus far concerning the LPDA have been with the assumption that the LPDA is basically a clever way to get broadband, properly impedance-matched (i.e. resonant) operation over a wider spectrum than is possible with Yagi-Uda designs. And while this is true, and while this has been one of the important features for CATV, this is not mandatory.

As Tony Bickel (formerly Chief Engineer for CADCO, Inc.; now with U.S. Tower Company) has shown in practical commercial-design CATV logs, many of the desirable features of the log can be utilized for single-channel operation as well.

Features such as good match (typically 16-22 dB in CATV antennas), good front-to-back ratios (typically 26-32 dB in CATV antennas) and good front-to-side ratios (typically 25-30 dB in CATV antennas), (all found in the LPDA) are normally at a trade for gain. To put it another way, a typical log of "X" boom length will typically exhibit *lower* gain (by 1-3 dB) than a typical Yagi-Uda of the *same* boom length. The reason for this should be obvious: the log is exhibiting its gain over a much wider span of frequency than the Yagi-Uda.

However, as Bickel pointed out with his initial antenna line for CADCO, the LPDA does not *have* to be a wide frequency coverage antenna. Yes, it was initially attractive to people like home-antenna manufacturers because it *did* exhibit such a characteristic. Then when CATV antenna manufacturers adapted the log for CATV use (SCALA was first to do so), the extent of frequency coverage was typically *limited* to either high band or low band. Eventually, low-band antennas were further refined into channel groupings such as 2-4, 4-6, 3-5, and so on. Bickel merely *refined the refinement* when he developed *single*-channel logs for low-band channels. But in the process, he picked up as much as 3 dB additional gain, for equivalent boomlengths, as other 2-4, 4-6 or 3-5 antennas offered.

So the gain of a log does not have to be lower, for equivalent boom length, than a Yagi-Uda. This is a tradeoff the design engineer selects, frequency coverage for gain. The transformation of the basic Yagi-Uda antenna, in the 50's and early 60's, from a *single*-channel antenna (and *that* was stretching the facts in that era!) to a multiple-channel antenna (ala early TACO Trappers and Winegard Interceptors) was a similar set of tradeoffs that home-antenna manufacturers also went through. The LPDA design offered considerably *fewer design problems* in making the transition from narrowband to broadband (the LPDA probably began even on paper as a broadband design). In actuality, the LPDA has transitioned *backwards* from broadband to (relatively speaking) narrowband. It is interesting to note that some narrow frequency coverage VHF and UHF communication-circuit antennas now are LPDA design.

Not a Backyard Project

The LPDA design, that is from mathematical scratch on paper, is probably not a backyard project. A bundle of tubing, tools, and an SLM won't get you very far with an LPDA. There are simply too many concise variables. This is because the LPDA, unlike the Yagi-Uda, has been reduced to a very precise set of formulae. In the Yagi-Uda design, you can change (or vary) element length and element spacing, and then try to readjust the match to make the new variation "play." In the LPDA design you have element length, element spacing, boom taper (delta function), and a host of other inter-related functions. Changing one may have no apparent reaction on *one single frequency* (or channel), but you can be sure that at *some* other frequency within the antenna's design frequency coverage range, something unkind has occurred.

Variations of the LPDA

If the LPDA is an antenna with so many desirable features, why are there still Yagi-Uda antenna designs sold?

Primarily because the LPDA is *not a perfect antenna*, and some of the less desirable features are not so objectionable *in the Yagi-Uda design.*

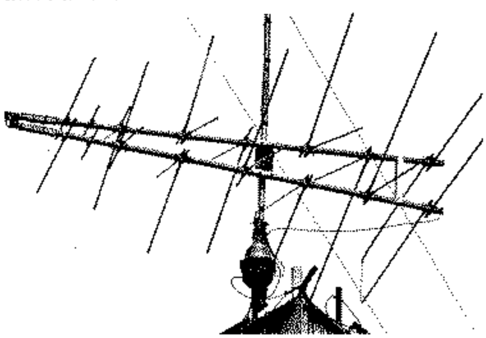
Foremost among these is the forward directivity of the LPDA. Of course, different designs have different numbers, but typically an LPDA is from 25-50% broader at its 3 dB directivity point than a comparable Yagi-Uda. Which is another way of saying that the Yagi-Uda, when properly designed, is better at *pinpointing* the desired signal than the LPDA. Of course this is at a sacrifice of side and rear lobe control on the Yagi-Uda.

If the increased directivity of the Yagi-Uda is attributable to its greater number of passive directors (it is), then what is to stop the designer from placing strictly passive directors ahead of the LPDA dipoles and calling it a combination antenna (i.e. Yagi-Log)? Nothing; many have done it. Unfortunately, in the process of placing passive directors *in front* of the LPDA we re-create many of the undesirable features of the Yagi-Uda. This includes some sacrifice of side and rear lobe control. So there is no easy way to improve directivity; it is *always* in exchange for some of feature.

More common is the addition of passive reflector(s) on an LPDA design. This has the feature of improved front-to-back ratio (although not dramatic); side lobe control is modified only slightly. In other words, the *real culprit* in side-lobe control is the passive *directors*, not passive reflectors.

Mounting LPDA Antennas

Which brings us to the mounting advantages with LPDA antennas. Because of the "hot boom" nature of the LPDA (i.e. the booms are part of the transmission line antenna feeder system), the antenna cannot simply be grabbed at the center and bolted to a piece of pipe. To do so would short out (i.e. deaden) all of the antenna from the boom-to-pipe short *backwards* (although the portion *forward* of the short would still function). The LPDA is fed from the front or nose, primarily because this is the most convenient end to attach the transmission line and accomplish the goals of the design. The balanced antenna feeder nature of the twin booms provides another plus. By routing the unbalanced coaxial cable feedline back to the rear of the antenna (and hence the mounting face of the tower) *through* (along/inside) *the shield side of the feed cable boom*, a matching system is derived. The shield of the unbalanced cable, *lying inside of the active boom* (but insulated from it by the poly jacket on the feedline cable) is effectively treated as an *"infinite balun."* Thus the shield side boom performs one more useful function for the LPDA designer: *it serves as a matching device for unbalanced to balanced transmission lines!*



Note boom delta-taper in Jerrold J283X antenna; log covering channels 2-13 (plus UHF with attach-on separate booms).

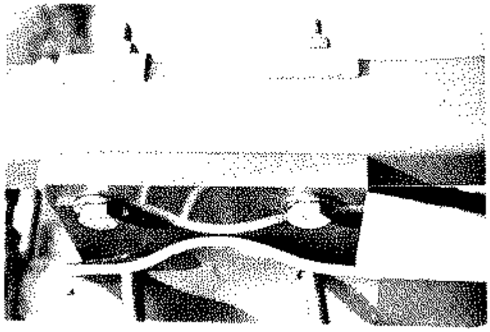
Therefore most LPDA designs are mounted from the rear, where the booms are "cold" and where whatever mechanical mounting configuration required can (if the designer wishes) short the two booms together without degrading the performance of the antenna.

Of course when antennas become fairly lengthy (i.e. boom length gets large), the mechanical problems associated with suspending the LPDA *from the rear* increase rapidly. Handling ten feet of twin booms from the back is one problem; handling twenty feet of boom from the rear is *quite something else!*

For this reason many of the low-band rear-mounted LPDA antennas are shorter (in boom length) than a purist design engineer would like. This is part of the reason that CATV LPDA antennas often cover only channels 2-4 or 4-6 or 3-5 for example. The design engineer stuck with a rear-mounting antenna requirement almost has to decide how much metal he can safely suspend from the rear, and then design into *that boom length* as much gain and frequency coverage as he can. Frequency coverage (i.e. 2-4 vs. 2-6) is traded off first, although by designing to maximum length vs. maximum gain, gain suffers also.

The rear-mounting feature of the LPDA is a boon to CATV antenna systems: it makes tower system design much cleaner, and it reduces or eliminates the need for gate booms. But the tradeoff is gain.

In some CATV Log antenna lines the tradeoff is simply rejected, and LPDA antennas for single low-band channels (i.e. 4 or whatever) are designed with attention *only* to the gain, pattern, and match functions. This results in the boom lengths being close to 20 feet for some channels; and we are back to center-of-boom mounting once again. An LPDA *can* be mounted from the center of the boom, provided the designer



Insulating mechanism for center-mount log is required to keep antenna-feeder (hot) booms from shorting out at that point

makes allowances in the mounting system to ensure that the booms are *insulated* from the vertical antenna support pipe. Typically, fiberglass or plastic (i.e. insulating) spacers are designed so that the booms *do not come into contact* with the vertical support pipe. However, this does present one field-practical problem: the exit of the feedline from the shield side boom and getting the feedline back to the tower. Some practitioners advise you to drop the feedline cable out of the shield side boom (typically the boom closer to the ground below) and to slope it downward toward the tower at a small angle, *keeping it out of the field of the antenna* in the process. Others tell you to wrap the feedline down under the shield side boom and to *tape it along the outside* of that boom until you arrive at the vertical support pipe, where a sharp 90-degree bend gets the feedline out of the antenna field in a hurry.

Conclusion

This completes our *CATJ* summer "Basic Antenna Series." Parts one and two, dealing with basic antenna-design parameters and the Yagi-Uda design, appeared in the June and July 1975 issues of *CATJ*.

Readers are also referenced to the *June 1974* issue for a special report on antenna phasing techniques for co-channel elimination and to the *July 1974* issue for a special lengthy report on constructing your own 20-40-foot parabolic dish antennas. Back issues referenced are available in very limited supply from *CATJ* ($1.00 each); the *July 1974* parabolic report is available *only* as a reprint (also $1.00 each).

Equipment Review

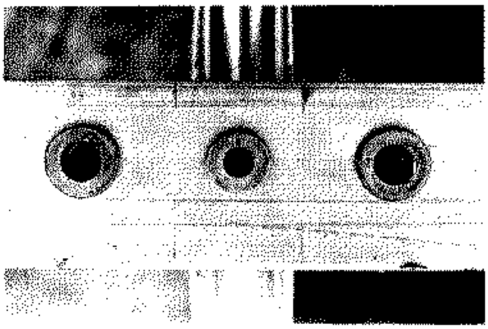
LINDSAY 10LE213FMU IS BUILT LIKE A TANK

The Lindsay Model 10LE213FMU Search Antenna is built like a tank.

Canadian operators have never been short on the use of stout, and the Lindsay Search, manufactured in Canada but distributed in the United States by Toner Cable Equipment, Inc., is no exception.

In our July issue of *CATJ* we reviewed the Jerrold J283X Search Antenna and reported that we were impressed by its more-than-expected ruggedness, its performance for its size, and the value of the product (vs. the cost for same).

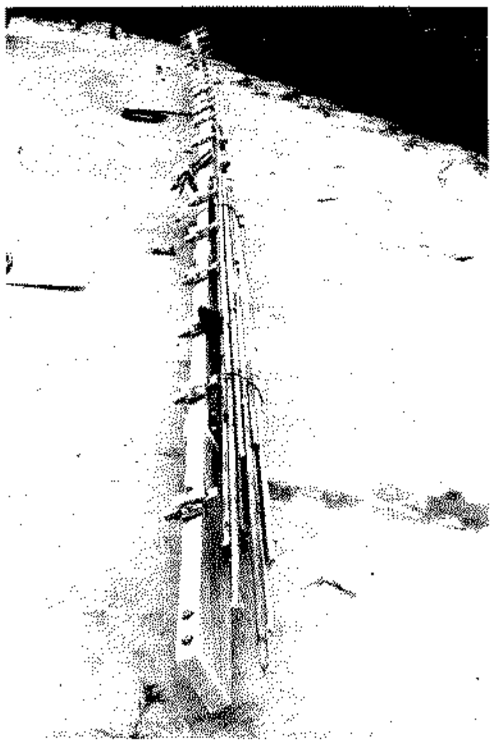
The Lindsay Search Antenna entry into the market is bigger, weighs more, costs more, and does more. Where one typically strong CATV-type person can hoist the Jerrold J283X over his head with one hand and never miss a pulse beat, there are probably few if any CATV types that can lift the Lindsay Search over their head with one hand; and even two hands presents some distinct groaning and moaning.



Elements bolt to boom with captive inserts mounted in boom; three per element on VHF

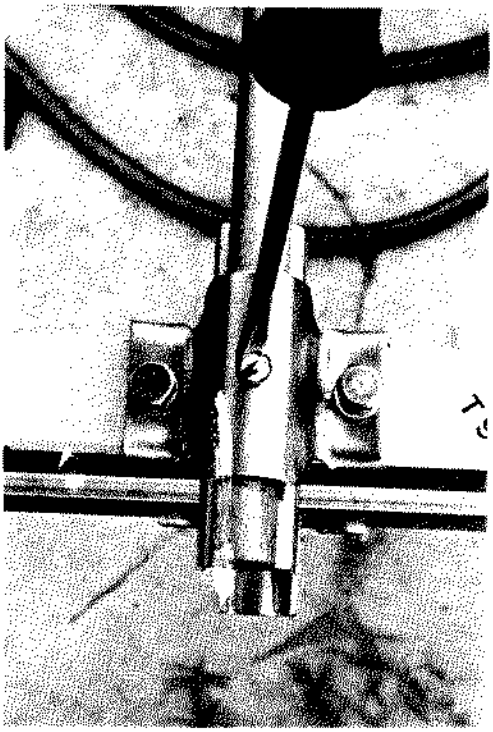
Beyond that, the Lindsay Search and the J283X can*not* be fairly *compared*. One is designed to withstand severe Canadian winters and still work in the spring; the other might not make it past Christmas *in the Canadian* environment. And like any other trade-off, you get Lindsay kind of ruggedness for a price factor of nearly three times the J283X.

The Lindsay Search Antenna, model 10LE213FMU, presents the reviewer with more than a few problems. It comes out of the carton pretty much assembled; it should take you about 90 minutes to complete the job if you don't hurry. All elements are marked as to their location on the respective booms (two like any log) with corresponding element (marked) numbers and boom (marked) numbers. The data sheet with the Lindsay search *doesn't* tell you very much, but the only place you *might* get into trouble is when mounting the elements to the lower boom (these elements and the boom are marked with the "B" series numbers; for *bottom* boom we suspect). The lad who drew the sketch of element placement misdrew the location (i.e. the hole location) for the exiting VHF feedline, and unless you stop and think about it, you *could* by following the sketch *exactly* end up with the bottom boom elements pointing in the wrong direction (i.e. on *wrong* side of boom). If you did such a thing, the antenna would not *look* like a log; one side would look as if you had shaved the elements off, and that ought to stop somebody from hanging the antenna up incorrectly assembled.



Out of the shipping carton, most of the hard work is done for you; remainder requires approximately 90 minutes

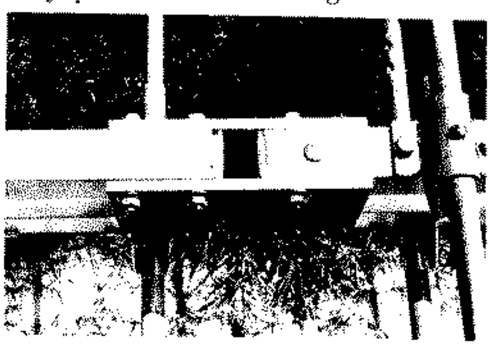
The construction of the Lindsay Search is typical *John Thomas* tough. Notice in the accompanying photographs that when mounting an element into position, you are securing it between a set of "jaw clamps," plus stabbing a stainless-steel machine screw through the element and into a boom-mounted retainer-nut. The elements are crimped for sealing out moisture and junk on the outside ends, and sealed with wooden dowel inserts on the mounting (boom) end. The tubing is sleeved at the mounting point, which means that where the element clamps to the boom, you have a sleeve, the element tubing, and a wooden dowel. It is kind of hard to argue with that kind of design; a twenty-pound crow landing on the end of one of these elements *probably* would not snap the element off (although we admit that we did not try this test).



Stainless-steel machine bolt centers element in mounting clamp, is held in place with captive nut

The clamps that hold the elements in position on the boom are also secured *into the boom* with inserts that perform the function of a nut. Again, it is kind of hard to fault this kind of construction. In the process of installing the elements in their respective places, we *expected* to have some difficulty getting some of the holes to line up. After all, the holes have to be *exactly* in line for the over-element clamp, the elements, the seat under the elements, and then finally the boom-mounted inserts. That is four holes that have to line up pretty closely; we are happy to report they all did. Where a couple were off *just a tad* we found that by loosening the two larger bolts that secure the assembly to the boom that we got sufficient "play" to make the more critical stainless machine screw fall into line through its four holes and into the boom-mounted insert nut.

None of this gives the antenna reviewer any problems. The problem comes with trying to decipher *just exactly what it is the antenna-design engineers at Lindsay had in mind* when they put this antenna together.



Non-log portions are insulated from log sections

The antenna covers UHF/VHF and FM. Not unexpectedly, the UHF portion is handled separately. Lindsay *could* have built on a small UHF log and allowed it to feed signal with the VHF booms (i.e. feedline). But they chose instead to handle the UHF section as a separate antenna, insulating it from the balance of the antenna in such a way that it ends up with its own downline output. This makes considerable sense because the UHF portion of the search in many cases requires its own UHF pre-amplifier. If both VHF and UHF come out of a single-antenna "spigot," then you have to install a V-U band separator at the antenna to divide the two spectrum sources for preamping the UHF alone, or both separately.

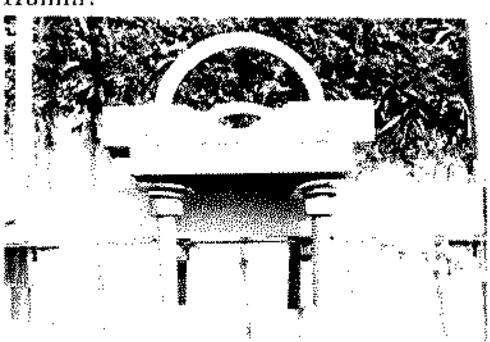
So far so good; that we can understand. And even the further insulated mini-sub-boom that mounts *ahead* of the UHF log section is comprehensible. It places some passive directors in front of the active UHF log section of the antenna, resulting (the theory book says) in *improved UHF directivity* and perhaps a little more gain in the process. Whether John Thomas calls this UHF section a Yagi-Log or a Logi is unimportant.

But the VHF section almost defies explanation. Not that *we have to* understand it to use it, or review it. But it *helps*.

The VHF section starts off at the back end with a comprehensible approach to logs. There are two booms, insulated from one another, and elements sticking out of both booms in opposite directions. But beyond that, the VHF portion of the antenna gets a little difficult to follow. We'll say this, Lindsay has put some of the old mystery and magic of the late 50's and 60's back into the antenna business! We can remember looking critically at design after design *in that era*, usually in the home (fringe) antenna field and pondering "now I wonder what that set of elements does, or is supposed to do." We often came to the conclusion that many of the miscellaneous pieces of tubing hanging hither and yon in seemingly unrelated locations were mainly in place to (1) confuse competitive design engineers and (2) convince the semi-literate customer that *this was some antenna!*

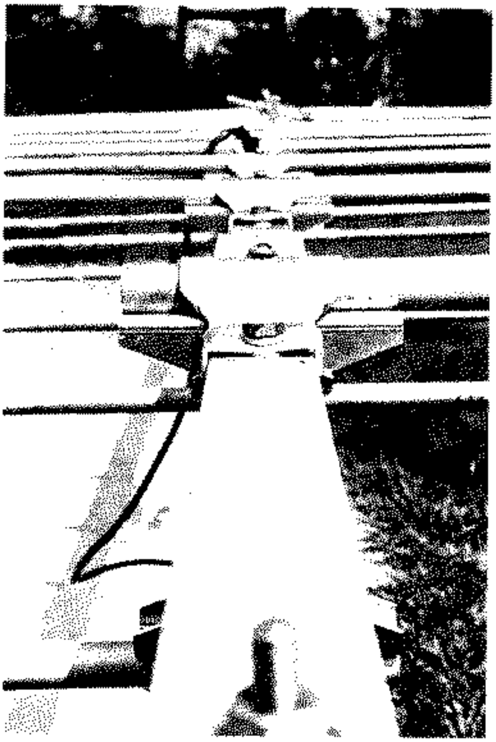
We think too much of Lindsay to suggest either of these for explanation in the instant case, but that *old* feeling *does* return.

Some of the miscellaneous tubing does make *some* sense if you have an open mind. For example, directly in front of the VHF log section (but insulated from the log section of the booms) are five *purely passive* elements. They undoubtedly are where they are because they are intended to increase the directivity of the log portion (Yagi-Log or Logi again). One of these five elements presents something of a puzzlement however. It looks like an unfinished "T" match, unfinished in the sense that the "T" portion is present and accounted for, protruding down below the main element. Only nothing connects to the base of the T; in *the* location where *were this a true "T" match* a feedline would be attached. Humm?



Antenna center-mounts, insulated from support pipe

Then there is the frequent log-element use of insulated element sections. The longer elements are the proper length; only about 60% of the way between the boom-mounting point and the end of the element on every second element the tubing is broken for continuity with a plastic-like insulation material for a couple of inches; then the element continues its merry path to the proper crimped end. *One explanation* for this is that these insulated end pieces are *intended* to function as directors for the high-band portion of the log. But that is a little loose on interpretation because there seems to be no active dipole elements for high band at the back of the antenna (i.e. where the longer elements/lower



Elements are double-thickness seamless tubing (i.e. sleeved), with wooden dowel in boom-mounting end

channels are handled).

Another explanation is the insulated elements sections closest to the booms are resonant on high band as active elements, while on low band the boom to insulator plus insulator to element end portion acts as a director. Directors do not *have* to be contiguous to be passive directors . . . *but it helps*. Usually when somebody does this, they install inductive (L) traps in the section where Lindsay has plain vanilla insulating material; traps acting to divide the elements for RF on two different frequency segments. But minus traps, we simply went away scratching our heads.

Anyhow It Works

In spite of our questions about some portions of the design and the urge to simply remove those pieces of tubing we could not rationalize a need for, we went ahead and installed the antenna for testing as it was designed.

Mounting the Lindsay 10LE213FMU Search is a bit of a chore, *unless* you are rigged and prepared for it. The antenna measures 193" long and 114" wide at the widest point and weighs approximately 100 pounds loaded and ready to mount. This is too big and too heavy for one man to manhandle into position.

LINDSAY 10LE2-13/FM-U SPECS

Forward Gain	
High band	12.5 dBi
Low band	9.0 dBi
FM	6.0 dBi
UHF	10.5 dBi
Weight	100 Lbs.
Boom Length	193"
Width (max)	114"
Crossarm	1.5" Square
Elements	1.25" tapered to 0.37 OD, damped
Mast	Up to 2.5" OD
Pricing	$403.00

Manufacturer—
Lindsay Speciality Products Co.
Lindsay, Ontario, Canada
Available in USA from:
Toner Cable Equipment, Inc.
418 Caredean Drive
Horsham, Pa. 19044
(215/674-5510)

The normal final resting position for any search antenna is atop a rotor. It should be noted that the U.S. distributor for the Lindsay line, Toner Cable Equipment, Inc., has a corner on the *complete search - antenna - package* market because they have thought out the problems associated with a search very carefully and packaged everything needed into one source. We intend at some later date to go into the practical problems associated with rotors and controlling them (and that includes getting voltage to rotors, 500 or more feet away from the control box), here in *CATJ*. In the interim, if you are having trouble finding the expertise for this kind of installation, contact Bob Toner.

Friendly Spoofing

We poke a little good-natured humor at Lindsay in this review, not because we are mean or want to make John Thomas mad. Simply because we have to hand it to Lindsay for putting a little mystery and glamour **back into** the antenna business.

There was an era in TV-receiving antennas, as noted in the text, where every home-antenna manufacturer had a brand-new, revolutionary design once or twice a year. In historical perspective, most of the new revolutionary designs were borderline shams on the poor gullible public.

It was not uncommon in that era for home-receiving antennas to be referenced (for gain) against everything from the dipole to the isotropic source, and it was often apparent that **some** of the home-antenna manufacturers had to be using **wet noodles for references** to get the gain claims they had in print.

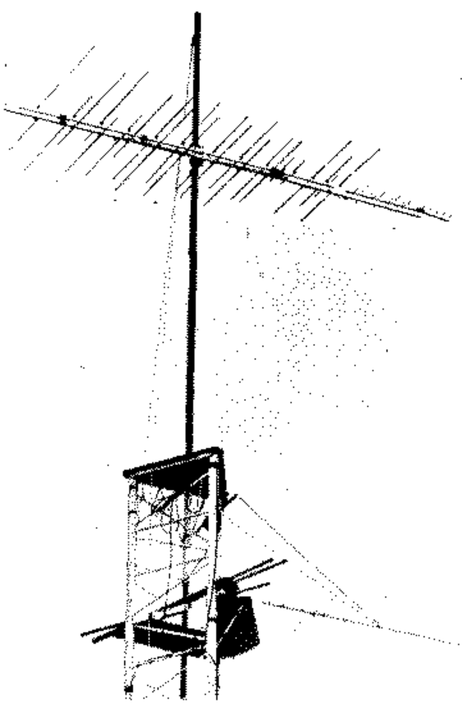
It was also not uncommon in that era for there to be plenty of extra tubing hanging about the antenna, tubing that defied logical explanation and which could only be explained by "one-more-piece-of-tubing-manship." I.e., if brand "X" added **a piece** of brightly blue anodized tubing at a right angle to their element chain, brand "Y" quickly followed with **two pieces** of brightly red anodized tubing at right angles to their elements.

That is all in the **past** now, and the well-faded blue and red anodized elements are coming down as people discover that cable's pictures simply look better more of the time than their super-duper antenna pictures do.

And so we hand it to John Thomas and Lindsay for the design of their search antenna. We only wish we knew which elements to remove and which to leave in place, without harming the antenna's performance. That sure is a big, strong (heavy) antenna, John!

Most search-antenna rotors go on the tippy-top of the tower. The Lindsay Search mounts in the approximate weight center of the antenna, on *insulated* mounts. This means the search antenna and its feedline are considerably *removed from the DC potential* of the tower itself. We mention this because of our concern for lightning; in the *February 1975* issue of *CATJ*.

If you can keep the rotor close to the top of the tower (i.e. don't run a spike very far above the top of the tower), and/or can stand on top of the tower to place the Lindsay Search on the pipe that protrudes out of the rotor (the rotating portion), *you will be in good shape*. As a *warning* only, don't expect to mount this antenna as a one-man exercise in tower gymnastics unless you have some pretty fancy tower rigging in place to lift the antenna for you. One man can guide it all right, but lifting and guiding is beyond the average kind of tower guy.



Lindsay 10LE213FMU Search "Logi" is a large antenna, rugged enough to withstand tower-top weather and winds

Our antenna check-out procedure with the Lindsay Search was not dissimilar to that employed with other antennas we have had on the *CATJ test range* this summer. We ran apparent gain and apparent pattern checks but feel far from confident enough about our "numbers" to print them here. Again, *antenna test-range measurements are fraught with deceptions and errors.*

We satisfied ourselves that the antenna is apparently capable of living up to its listed specifications (see table here). We were particularly pleased with the *directivity* on VHF. If anything, *in our situation,* it appeared to be better than the spec-sheet data. All of that funny business with passive directors forward of the log portion may be *hard* to decipher, but *something* is giving the antenna some added directivity that the log portion *alone* cannot account for.

Overall, the 10LE213FMU functions about the way you would expect a *first-rate* deep-fringe home-receiving antenna to perform. That is *not* a slam . . . a lot of people outside of cabled areas must still depend upon their own antennas. In fact, if more of them had an antenna like the 10LE213FMU search above their roofs, the selling of cable service might well be more difficult. On the *other* hand, if they didn't have an 18-40-inch face tower to support the 100 pound-plus of antenna, they might quickly discover that cable was better than repairing their roof and putting the Lindsay antenna back up once or twice a year!

TRICKS WITH THE LAUFER DO-IT-YOURSELF ANALYZER

In the July *CATJ,* reader Jerry Laufer of Gill Cable (San Jose, California) described an interesting package which can be put together by most CATV system personnel; a sort of do-it-yourself spectrum analyzer.

The "secret" to the Laufer development of the "everyman's spectrum analyzer" is that you have on hand a Jerrold (or other brand) RSC-* type system converter. Modern CATV subscriber converters feature varactor tuning, which as Laufer pointed out in July, are amazing little solid state devices that *tune-themselves* when a voltage is applied to them. This is not unlike having a variable capacitor (i.e. RF tuning circuit) with a "motor" on it, and from a remote spot you power the motor which turns the shaft on the rotor of the variable capacitor, to tune the capacitor for you. Only with the varactor diode, as you change the voltage the varactor tunes automatically.

Now this is not exactly a new device or a new technique; but sometimes it takes someone with an "open mind" such as Laufer to set other "great minds" to turning. (The mind, you see, is not unlike a varactor diode; once a voltage is applied it tunes all over the place!) For example, the people at Mid State Communications (Beech Grove, Indiana) in their 1975 catalogue talk about a new product they are developing; "A unique new instrument for CATV that receives all system signals automatically at the input, and provides two outputs, one to drive a spectrum analyzer and the second to feed a receiver tuned to channel 3, which steps through all channels on the system automatically". The device, *the secret is out*, is a modified system converter ala Laufer.

Let's explore that one for a minute. If you have a RSC-* converter, and a ramp voltage to drive the varactor tuning, and a way to *control the ramp* "sweep speed", you could run the converter into a receiver in the shop, or in the front window of the CATV office, and step through all of the channels on the system automatically. In the shop, this constant "sweeping" monitor would let you know that everything was alright on the system on all channels all of the time. If you designed the ramp "sweep" speed to *hold* on each channel for a few seconds of time, you could sequence through 12 channels in less than a minute, without ever touching a channel (tuner) knob. Channels not in use could be "locked out" by going into the converter and bypassing the Trim-Pot for that channel.

On the other hand, the ramp voltage *could* be step programmed to simply "step over" the channels not in use.

Now if you are "scanning" each channel with a ramp voltage driving the varactor tuning in the converter, you could install an LED to light up as each channel is sequenced; placing the channel number above the LED so you know which station is being received at that instant in the scanning sequence. Once you have gone that far, if the LED is driven in conjunction with the varactor ramp voltage, you could "squelch" the LED to not light every-time (or anytime) that channel was missing. Which to take that presentation one step further, if you can turn on an LED by the presence of a signal on the channel, what is to stop you from sounding a buzzer or alarm or flashing a second light whenever a channel is missing? In effect, instant knowledge that a station is off the cable, thereby freeing up a person from having to watch for a blank screen. This would be accomplished with a limit-detector (or squelch) circuit.

Now if you are sweeping or scanning through the channels in question, you could also establish a warning system to alert (or alarm) you when a signal level *varied* outside of *pre-determined parameters*. For example, if a limit-detector told you when a signal was missing, how about a "window-squelch" that would tell you whenever a level on a certain channel varied outside of (say) +/− 1.0 dB?

Most of this has occured to Larry Dolan and Doyle Haywood at Mid State. "The 'unique new product' started out to be a simple box that would give the system two outputs; one to drive a spectrum analyzer and one to drive a TV receiver in the shop" notes Dolan. "Then as we got further and further into it, we found we had so many options that the cost of the machine was increasing very rapidly. Frankly, we see a market here but it gets smaller as the box gets more complicated. Perhaps this would be a good do-it-yourself project for *CATJ* readers" notes Dolan.

Perhaps it would. We are also reminded that down at TOCOM they check out their new DC-1000 series cable converters by simply hooking up a small low RPM motor to their thumbwheel channel selector knob (a friction shaft is all that is needed; no requirement that you tear into the converter). The motor drives the channel selector knob, which then steps through the channels. This checks out their converters for them before shipment, as part of final testing. You could do that with the TOCOM DC-1000; but not with a Jerrold RSC-* because the RSC series uses push buttons in lieu of a knob for channel changing.

If you could step your full CATV spectrum through one box, you could run the output of that box into a single "preview channel"; a channel dedicated to "brief glimpses" of what it was that all other channels had on the air at that minute. Which suggests that for systems going into PAY, that a simple sequencer on a "Movie Preview" channel would alternate between a static promotional display of the movie currently being offered on the pay channel, and 5-10 seconds of that movie every few minutes *as a teaser*. It is all very simple with varactor tuning. It ought to bring in PAY customers in droves.

Mods To Laufer

The July *CATJ* piece by Jerry Laufer included the dedicated use of an SLM (727 by Jerrold in his case) as a "detector" for the scope display of the signals tuned by the ramp voltage driven RSC-3 converter.

Actually, there is no need to "dedicate" an SLM to this purpose. The SLM provides (1) voltage gain, and, (2) selectivity (*some* is required), and (3) a handy detector, You could accomplish the same thing by substituting a simple bandpass filter (i.e. tuned to the output channel of the RSC-* or other converter) and a detector (see Page 37 of May *CATJ*). Or, run the output of the converter into a channel (3) strip amp and then into the detector. Or, run the output of the converter into a processor/demodulator and take either RF out of the processor or video out of the demodulator. It all depends upon what you have around the shop. In short, you are not stuck with tying up an SLM, although in many cases that will be the easiest choice for you.

By not using the SLM, and substituting something with wider bandpass response (i.e. bandpass filter and detector) you *should* solve the scan loss problem mentioned by Laufer on Page 14 of July *CATJ*. At the same time, when you employ something between the converter output and the detector that has *no* gain (or loss as with a straight (BPF), you may have difficulty seeing relatively weak signals (such as off the air). This can only be solved by putting some gain back into the equation, between the converter and the scope display.

Retrace Blanking

The retrace spike present with the Laufer circuit can be eliminated by driving the Z Axis input on your scope (external blanking) with the sync pulse. In some situations you will have to "invert" the sync pulse to operate the scope properly.

The circuit in Diagram 1, developed by Steve Richey, provides an inverted signal for those who can use this approach, and a video switch to be used when the scope you have lacks a Z Axis input.

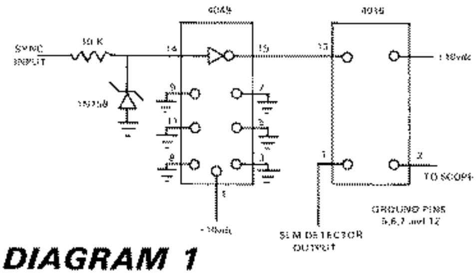


DIAGRAM 1

The IC's chosen are of the MOS type, and care should be exercised when handling them (i.e. taking them in your hand). MOS devices tend to blow easily until finally seated in the circuit and operational; static discharge is an enemy of most MOS devices (particularly those without built-in protective diodes). *Leave* the supplier-shipped protective "foam" on the IC's until you are ready to install them. Handle the units with the foam packing material on them for at least 30 seconds to "equalize your body charge". The IC's should be socket mounted with the whole unit on a small perf board. Construction is simple and should be completed in about 30 minutes time.

Happy inverting and blanking!

TECHNICAL TOPICS

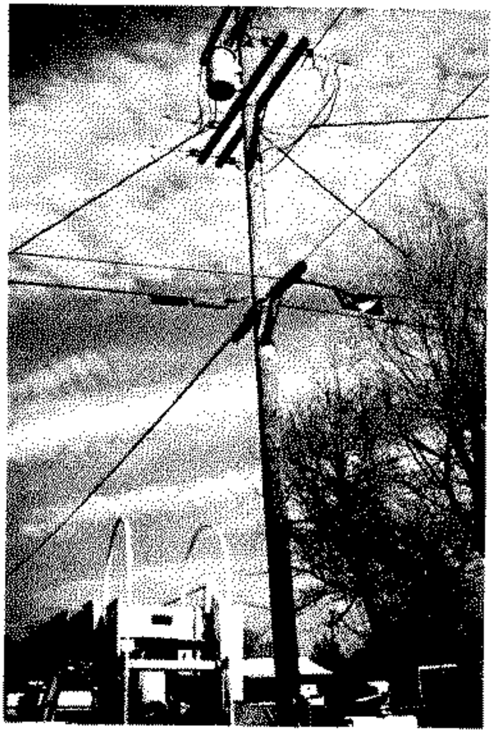
SORRY — WRONG NUMBER!!!

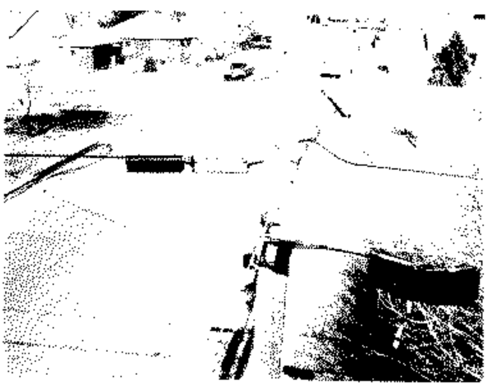
This, class, is a lesson in telephone technology. The telephone, in case you forget, is that instrument which a movie star of the 30's picked up and hurled against the wall of his office with the profound statement "Now. . .**that** is reliable," as he demonstrated that it still worked after the bashing.

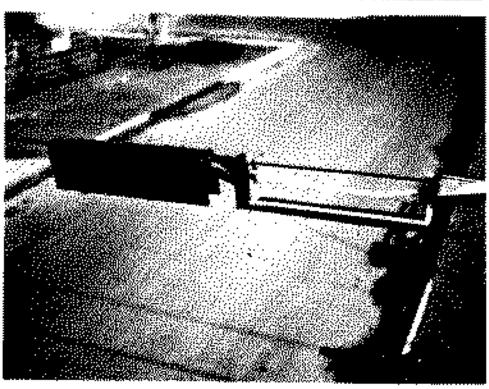
Notice please, in the first photo, that we have one of your standard 35-foot joint utility poles. Atop the pole is the usual power mish-mash, including three house service drops. Power house drops are nice because without them our customers would have to rely on Sony battery-operated sets. Notice that this is obviously an intersection pole with telephone distribution service lines crossing in two directions in the communication's space on the pole. So much for the long shot.

In the second photograph you will notice that on the far right we have a nice telephone company weather-bag, surrounding (i.e. enclosing) what is apparently a splice of the Telco line at this point. Telephone companies like to use nice weather bags, because they have a guaranteed rate of return and lots of public money to play with. Also notice just left of the pole we have the start of a new Telco splice; the splice-frame is in place, and the weather bag is secured left of the splice location awaiting the return of the telephone-company serviceman (he went to lunch).

Now in the third photo we "zoom in" on this **unfinished** Telco splice. There hanging on the strand is the splice-frame with those







nice Telco boots on either end and the ever-present weather-bag. Notice, if you will, that the jacket on the cable has been removed by the telephone-company workman and that he is down to a white inner material which looks surprisingly like foam coaxial cable.

In fact, it IS foam coaxial cable. In fact, what this faithful employee of the telephone company has done is to meticulously prepare **a section of CATV foam coaxial cable** for a splice! He has even removed (it shows in our original color print) the braid shield from the CATV cable (i.e. this short piece has no shield for the length of the splice).

Several questions come to mind. Did the telephone man stop work at this point because he couldn't find a page in his **splicing manual** that dealt with this "funny" kind of cable? Or did he **really** go for lunch? Had the CATV crew not found the splice (service beyond this point promptly ceased and, you guessed it, the **phone** rang off the hook), would the telephone-company man have returned to the job and proceeded to "splice it"? Or, what the devil was he splicing a perfectly good piece of cable for in the first place? I.e., do telephone-company personnel routinely **make work for themselves** by seeking out perfectly good pieces of cable and then spending half a day installing a splice?

That, fellows, **is what happens when you have a PUC-mandated guaranteed-rate-of-return atmosphere!** (Photos and story courtesy of Chuck Kee, Key TV, Redmond, Oregon.)

REGARDING COLOR ADDER—

Response to the June **CATJ**, Pages 16-18, circuit on the **Color Adder** (adds red to black and white weather channel displays) far exceeded our expectations. In fact, from a reader interest aspect, very few features in CATJ have ever earned that much response.

Author Steve Richey advises that **some** systems may experience **some** problems with the Color Adder on **some** receivers. It seems that not all color receivers operate their **color killer** circuits from the same "sense-point". Sets that operate the color killer portion (i.e. that which turns off the color circuits and color guns in the CRT when there is **no** information present in the color spectrum) from the color sub-carrier respond just fine to the Color Adder. This is because the Color Adder attempts to "fool" the TV receiver by injecting a 3.58 MHz ("color") sub-carrier into a black and white picture.

However, receivers which kill color by sampling the color **burst** present (killing color when there is no color **burst**) will **not** show color when the Color Adder is operating. Simply because the Color Adder adds a (color) sub-carrier to the signal; **not a color burst** to the signal.

Richey advises that he is working on a Color Adder-II now; one that is still basically simple, but which will offer multiple colors (in addition to red).

There has also been some confusion about the IC used in the Color Adder. We tagged it as a "1702 Quad two input positive NOR gate device". Actually, it is a 7402 (**not** 1702). However, the Motorola people stick a "1" in front of it (making their version a 17402) while Signetics sticks other numbers in front of the " . . ./7402". All commonly have "7402" at the "end" of the nomenclature however.

Finally, Steve Richey wonders (aloud as it were) "how many people would be willing to make some mechanical changes (i.e. adding some micro-switches) to their weather machine carousels (the part that rotates with the instruments mounted on it) **if** in the process they could have alternately red, then blue, then green (for example) instrument faces on meters that turned before the camera?". Your inputs directly to **CATJ** will be passed along to Steve.

Missing Credit

In my pre-publication copies of the July **CATJ** I was surprised to find that the article on our low cost spectrum analyzer neglected to credit Mr. John Messmer of our company as a co-author. Actually, John did the total design work and construction of the Low Cost Spectrum Analyzer. The only thing I did was write the article and take the pictures! John has designed and built other neat devices such as an automatic Hum Mod meter, slow scan sweep for a chart recorder and a low cost remote level recording device. Some of these devices are being designed for ultimate application in a fully automated CATV System Test Package.

John Messmer holds a BSEE from California Institute of Technology and worked for two years as a power supply design engineer prior to joining Gill Cable in October, 1973.

Jerry Laufer
Engineering Manager
Gill Cable, Inc.
San Jose, California 95112

Our complete apology to John for the oversight. As evidenced by telephone calls and letters to CATJ from readers, and this month's follow-up staff report on the July feature, the work done by John Messmer was dead on target for CATV needs. We'd like to make it up to John by publishing additional Messmer creations . . . and this time to balance the scales we will leave Jerry Laufer's name off of the article!

Back Copies — CATJ

Recently the requests for back copies of **CATJ** has risen dramatically. Most often requested are June 1974 (featuring co-channel data), and various fall 74 issues. For the most part, back copies of **CATJ** are **not** available. There are limited numbers still remaining of the following issues, however, and as the supply lasts they are available postage paid for $1.00 each:

August 74 — (featured one-way signaling, trunking vs. second headend, push-pull amplifier designs);

September 74 — (featured VHF-UHF wave propagation, a full line extender plant design, and preparation for 3-31-77);

October 74 — (featured VHF-UHF wave propagation, Part 1 of four part analysis on SLM's, and report on MATV systems run like CATV systems).

Additionally, the exceedingly popular **July 1974** issue article on building your own **20-40 foot parabolic dish antennas** has been reprinted and is available for $1.00 per copy.

Address orders to **Janet Carpenter, CATJ, 4209 NW 23rd, Suite 106, Oklahoma City, Oklahoma 73107.**

UHF Changes

Several influential broadcaster groups, including NAB and AMST, are preparing to file with FCC request for Rule Making which would have effect of forcing receiving industry to "step up development program" **for more efficient UHF receiving systems at the home viewing level.**

Most important items in petition will ask that Commission "immediately" **drop maximum permissible UHF tuner noise figure from current 18 dB (Nf) to 14 dB. This compares to the current VHF tuner Nf average of 6.9 dB. The 14 dB Nf mandate would be a** "way station" **to even lower numbers; probably as low as 9 dB eventually, a number now cited for European UHF tuners. Effect would be dramatic in UHF fringe areas were UHF tuners to meet 9 dB spec eventually.**

Other items sought include FCC ruling that all receivers have permanent UHF antenna (most employ add-on loop now). "equivalent to existing VHF permanent antennas" **(most VHF antennas are one or two rod** "rabbit ears"**). Then group wants FTC to force UHF lead in line and antenna manufacturers to specify UHF receiving equipment performance (i.e. rate antennas for gain and range).**

Receiver industry, forewarned, **is naturally opposed to such ruling.**

Editor:

We would like permission to reprint pages 10 through 41 of your February 1975 issue; in particular the two features entitled "It is Not Nice To Fool With Mother Nature" and "Transient Clipper For CATV Power Supplies". The reproduced articles will be for in-house distribution only.

J.T. Carlson
Chief Operations
Western Tele-Communications, Inc.
Portland, Oregon 97205

Mr. Carlson:

Your letter gives us an opportunity to respond in-print to similar requests received weekly by CATJ. We are tickled to death to grant such permission (and hereby do) for such internal reprinting and distribution of CATJ topic matter. As a matter of fact, if other readers (i.e. companies) have similar requests, you may go ahead and reprint CATJ material for internal (i.e. staff) use as you see fit; provided only that CATJ is referenced. We would always appreciate a copy for our files.

Editor:

Your current series on Antenna Basics (June, July and this issue-Ed) is very good. I personally have a lot of difficulty explaining antenna basic design to people **without** some basic antenna engineering background, and I think you are doing it very well. I would appreciate some extra copies of these issues for our antenna-lab people at several of the Universities here in Northern California.

I would like to make this point regarding broadbanding of Yagi-Uda design antennas. The use of two dipoles really does **not** accomplish **much** for broadbanding: it is really the taper and spacing of the parasitic directors that makes the antenna function over a 4-6 MHz spectrum. A dipole is broadband by nature anyhow. All Yagi-Uda antennas, especially in the low band TV region, are compromises. We have no difficulty getting 10 dB gain from a five element Yagi-Uda at 450 MHz. But at channel 2, an honest 6.75 dB gain is hard to come by. You have to compromise the boom length, as you point out; you have to compromise reflector length and spacing (it is often true that at channel 2 the reflector is resonant at the video carrier frequency and passive at the higher end of the channel) and many other things just to get even 6.75 dB gain over a dipole at channel 2. Many antennas that are of a **poor** design **may look better** on a signal level meter **than a good antenna.** This is because if the designer **peaks response** at say the video carrier frequency, he has more gain there; but by the time the antenna's response curve gets to the color sub-carrier or audio portion of the (low band) channel the gain may be **down 3-4 dB.** This fools people who have no way to measure response through the full channel. Other designers simply 'go up on the roof' and design for middle of the channel; resulting in the swept bandpass (gain) falling off on **both sides** of the channel, such as at both the visual and aural carrier frequencies.

Bruno Zucconi
SCALA RADIO CORPORATION
San Leandro, California 94577

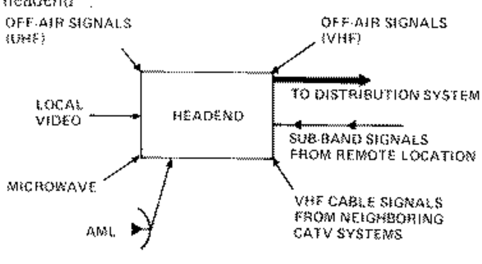
Bruno:

We are sorry to hear SCALA is so wrapped up in communications and government antenna work. The CATV industry misses you; hurry back!

We Goofed

In the August CATJ, report by Graham S. Stubbs, "Design Considerations For Modern CATV Headend Signal Processing Equipment". Pages 22 to 36; Diagram 1, appearing on Page 23 is incorrect.

Actually, that diagram goes with Steve Richey's article, Pages 15-22. The proper Diagram 1 is shown below. Mr. Stubbs wrote in his August report "Diagram 1 depicts some of the signal sources to be expected with a modern headend".



HEADEND INPUT SIGNALS

DIAGRAM 1

cata ASSOCIATE MEMBER ROSTER

In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry, who have been accorded ASSOCIATE MEMBER STATUS in CATA, INC. for 1975.

Anixter-Pruzan. Inc., 1963 First Ave. S., Seattle, WA 98134 (**D1**)
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA 95051 (**M8**)
Belden Corp., Electronic Division, Box 1327, Richmond, IN 47374 (**M3**)
BROADBAND ENGINEERING, INC., 850 Old Dixie Highway, Lake Park, FL 33403 (**D9, replacement parts**)
Burnup & Sims, Box 2431, W. Palm Beach, FL 33401 (**S2, S7, S8**)
Cable Dynamics Inc., 501 Forbes Blvd., So. San Francisco, CA. 94080 (**S8; equipment repair**)
CABLE NEWS, 2828 N. 36th Street, Phoenix, AZ 85008 (**S6**)
Cerro Communication Products, Halls Mill Road, Freehold, NJ 07729 (**M3, M5, M7**)
COMM/SCOPE COMPANY, P.O. Box 2406, Hickory, NC 28601 (**M3**)
DELTA BENCO CASCADE INC., 40 Comet Ave., Buffalo, N.Y. 14216 (**M4, M7, M8, D3, S8**)
Jerry Conn & Associates, 550 Cleveland Ave., Chambersburg, PA 17201 (**D3, D5, D6, D7**)
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA 16801 (**M1**)
DAVCO, Inc., P.O. Box 861, Batesville, AR 72501 (**D1, S1, S2, S8**)
DEVINES Trailers & Accessories, Grantville, PA 17028 (**M9, cable trailers**)
ENTRON, Inc., 70-31 84th Street, Glendale, NY. 11227 (**M4, M5, D4, D5, S8**)
GAMCO INDUSTRIES, INC., 317 Cox St., Roselle, NJ 07203 (**M5**)
JERROLD Electronics Corp., 200 Witmer Road, Horsham, PA 19044 (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**)
Kay Elemetrics Corp., 12 Maple Avenue, Pine Brook, NJ 07058 (**M8**)
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, NY 13057 (**M5, bandpass filters**)
MID STATE Communications, Inc., P.O. Box 203, Beech Grove, IN 46107 (**M8**)
Pro-Com Electronics, P.O. Box 427, Poughkeepsie, NY. 12601 (**M5**)
QE Manufacturing Co., Box 227, New Berlin, PA 17855 (**M9, tools & equipment**)
RMS CATV Division, 50 Antin Place, Bronx, NY. 10462 (**M5, M7**)
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, Az. 85036 (**M3**)
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN 46219 (**M8, bandpass filters**)
Theta-Com, P.O. Box 9728, Phoenix, AZ 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML Microwave**)
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**)
TONER Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA 19044 (**D2, D3, D4, D5, D6, D7**)
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN 46107 (**M8**)

NOTE: Associates listed in bold face are Charter Members.

NOTE: Supplier areas are keyed at the end of each listing, as follows:

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

Broadband Better Repped

Broadband Engineering, Inc., 850 Old Dixie Highway, Lake Park, Florida (33403) has completed arrangements for two new sales representatives. Broadband specializes in the supply of high quality replacement components for CATV equipment.

Broadband President Bob Savard pinpoints the two new regional sales representatives as **B.E. Duval Company** with offices in San Pedro, California (to cover California), and **Shea Sales** with offices in Maplewood, N.J. and Walpole, Mass. (to cover all of New England plus New York, New Jersey).

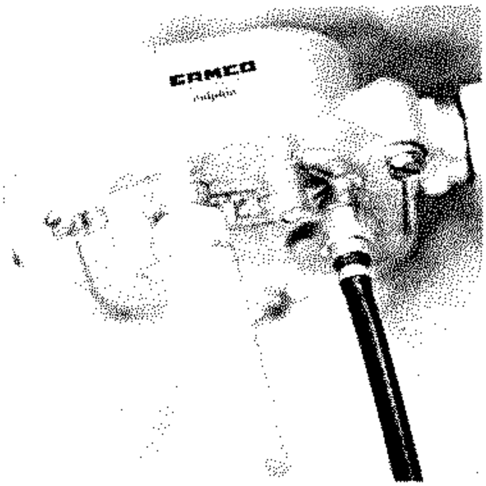
Phoenician II Really Moving

Orders for the recently developed Phoenician II amplifier line, shown to the CATV industry in New Orleans in

April, have now topped the 400 plant-mile range according to Theta-Com President Charles Maki.

The new amplifier line is intended to provide the small and medium sized system with hybrid equipment that is reverse capable for twenty channel situations. The new amplifier is also available as a drop-in replacement for existing standard Phoenician amplifier housings, such as Phoenician single ended equipment.

Lok It Up



GAMCO Industries, Inc., 317 Cox Street, Roselle, N.J. 07203 has a clever answer to the growing security problems associated with pay-cable operation. The problem is best defined as (1) installing a signal trap to keep specific subscribers from receiving certain (pay) channels, and (2) making it difficult (if not impossible) for the subscriber to by-pass the "security device" on his own.

Their answer is the NOTCH-LOK, a notch filter (trap) installed in a stainless steel cylinder which has a (GAMCO patented) locking device. The physical shape permits installing parallel mounting filters on multiple outlet directional taps, and the unit is inserted and removed only with the assistance of a special tool.

Full information, including through loss, lower adjacent channel selectivity and so on is available directly from GAMCO.

CERRO Bonds Drops

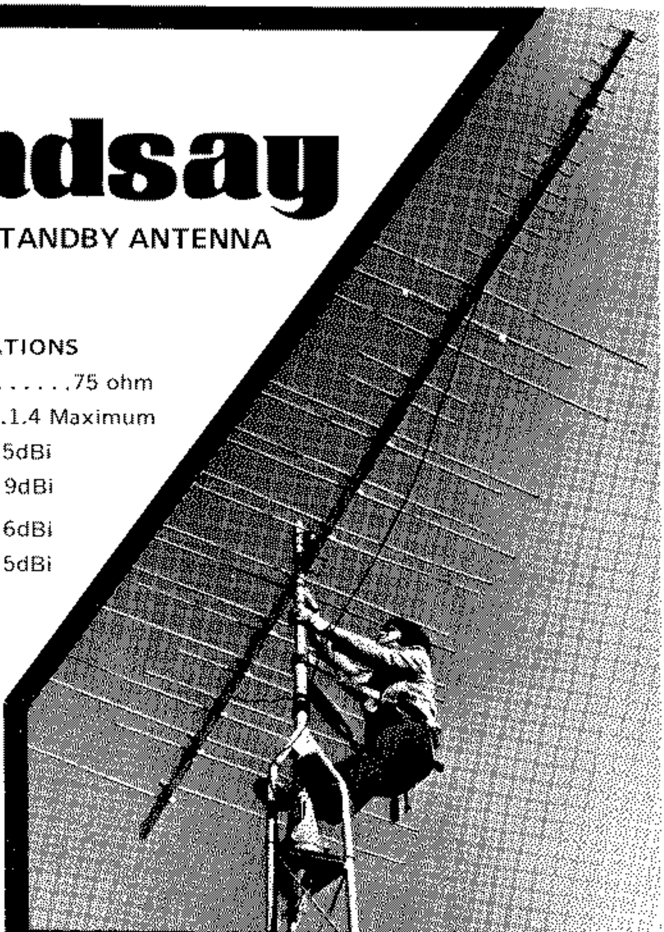
Cerro Communication Products has a new type of 75 ohm drop cable utilizing a foil shield which is bonded to primary insulation. This, according to Cerro, improves the integrity of shielding when combined with a drain wire or braid shield, and improves the art of placing a connector on the drop cable since "push-back" of the foil is no longer a problem.

The new cable family is available in different combinations of foil and drain (or drain wire) and braid shield in dual and messengered versions of RG/59 and RG/6.

Full information is available from Cerro Communication Products, Halls Mill Road, Freehold, N.J. 07728.

Lindsay

TEST, SEARCH OR STANDBY ANTENNA



ELECTRICAL SPECIFICATIONS

NOMINAL IMPEDANCE. . . . . . .75 ohm

VSWR. . . . . .1.4 Maximum

GAIN* Highband. . . 12.5dBi

Lowband 9dBi

FM 6dBi

UHF 10.5dBi

MECHANICAL SPECIFICATIONS

CROSSARM

1 1/2" Square Tubing

ELEMENTS

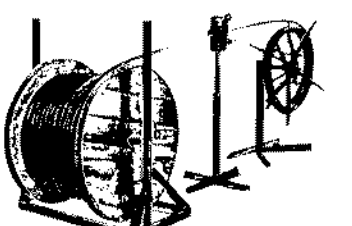
1 1/4" OD Tapered to 3/8" OD Vibration Dampened

U-BOLT

5/8" OD takes 2 1/2" OD Masts

ALL OTHER HARDWARE

Heavy Duty Rust Resistant



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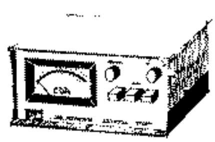
NOW AVAILABLE AS A PACKAGE

LINDSAY 10LE-13 FM/UHF Search antenna heavy duty Log-Periodic VHF/FM and UHF. Cornell Dubilier HAM/M heavy duty rotor with control consol & 8 conductor control cable. All ready to install on your headend tower.



Control Consol

C-D HAM/M Rotor

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In Canada, AML equipment is distributed by
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