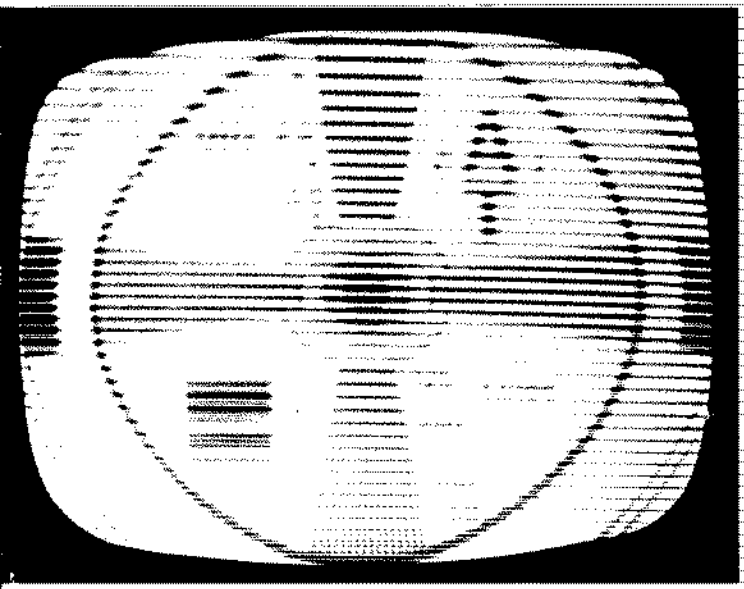
CATJ

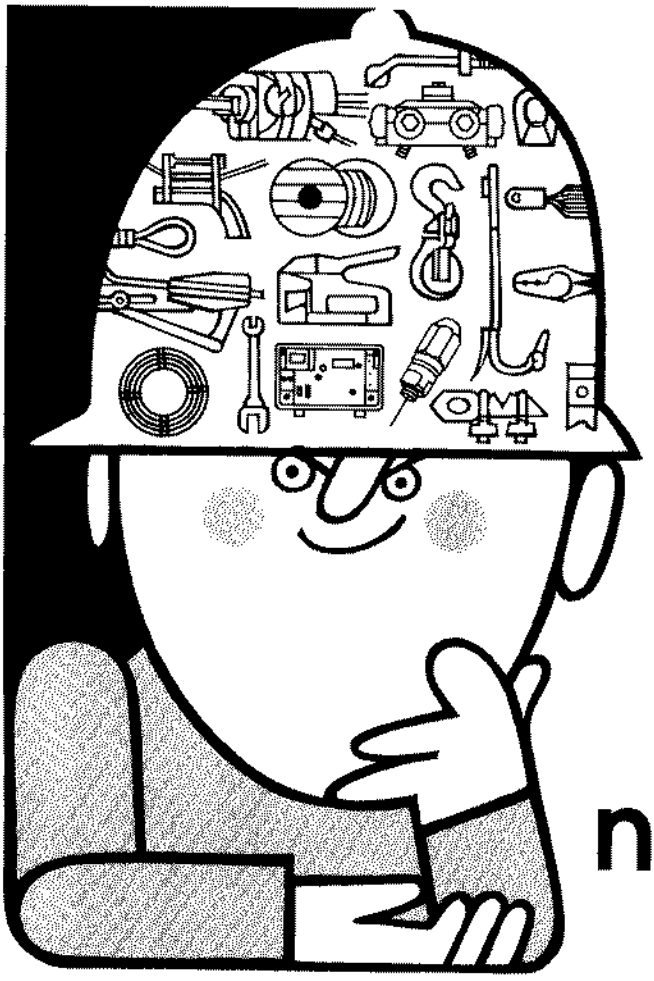
JUNE 1974



CO-CHANNEL AND ANTENNA PHASING

COMMUNITY ANTENNA TELEVISION JOURNAL

FCC PROPOSES NEW CATV RULES — PAGE 41



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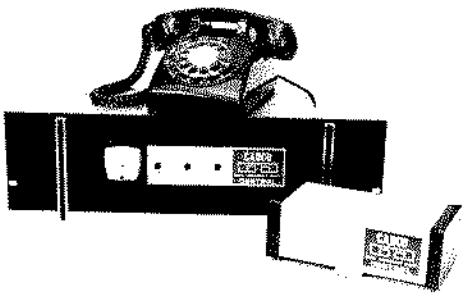
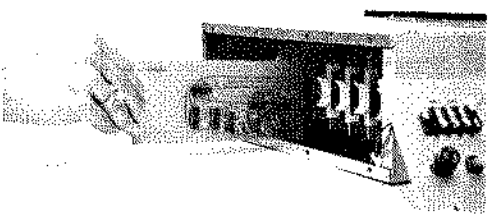
WHEN THE WEATHER TURNS BAD or any form of local emergency condition exists your town needs **more** than an announcement on the weather channel. You need the CEAS system (Civil Emergency Alert System). It is controlled from your local CD, police or fire station. It interrupts programming on **every channel simultaneously** and alerts all CATV viewers instantly.

NOW — the U.S. Government, recognizing the necessity and need for such an alerting system in ALL CATV systems will pay 50% of the initial cost and maintenance (operating) costs of a CEAS system. U.S. Government **CD matching funds are available right now.** And usually your town is more than willing to pay the balance of the cost.



IMPORTANT — the CADCO CEAS system functions with any head end! This includes strips, hetrodyne processors, de-mods and re-mods, and virtually any number of system channels, from 1 to 40! CADCO installed the first CEAS system nearly two years ago . . . dozens have been installed since. We are the innovators of this entire concept. CADCO knows the "ins" and "outs" of getting CD matching funds and will even help you "sell your city" on picking up the other 50% of the cost of the CEAS package(*). **No town should be without a CEAS system.**



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The TV People

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CATJ for

CATJ

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—CONTENTS—

OUR COVER

Co-channel elimination is a tough battle. It can't be "ruled away" by the FCC nor legislated away by Congress. It takes plenty of smarts and many hours of toil to solve. See feature report on Page 7, as CATJ attempts to take it out of the fringe.

CATA –TORIAL

KYLE MOORE, President of CATA, INC.

A document of immense importance released by the FCC in mid-April would amend many critical (and until now) mischievious sections of Part 76.

It is difficult to grasp that it all began for CATA just a little less than one year ago. Attending the first FCC Cable Bureau Regional Small Operators Meeting in Little Rock last June, I became incensed, not with the Cable Bureau but with an industry that had allowed itself to be worked into so many compromising positions, which I maintained were certainly *"not in the best interests of my public in DeQueen, Arkansas."*

Six weeks later CATA was formed. During the six weeks following Little Rock, and on through July, August and September, a total of 18 FCC meetings were held, and CATA supporters attempted to attend every one of these meetings to talk with CATV operators.

We also tried to talk with the Cable Bureau attorneys who chaired these meetings. We universally found talking with these attorneys neither painful nor even argumentative. We were pleased to find that the new young breed of attorneys engaged in Cable Bureau work were very open minded, very fair minded, and often a little apologetic for the "fix" that small (and medium and large) system operators found themselves in as a result of Part 76.

No, none of the attorneys ever allowed that Part 76 was bad; they all maintained that it was a necessary part of our growing up as an industry, but most (if not all) of these young attorneys were quick to agree that some portions of Part 76 were unfair to some or many operators and operations. Most were eager to have "inputs" from concerned operators as to how or *why (with emphasis on the why)* some sections of the rules might be changed or become more effective.

Our CABLE BUREAU COMMINQUE column in this issue of CATJ has a full report on this document, a detailed synopsis of the document itself, and the seven proposed rule making dockets.

Example: Should franchise terms be extended to 25 years in some situations? Docket 20021.

Example: How should an existing system that fails to win a bid for franchise renewal be compensated for his system? Docket 20022.

Example: Should federal technical standards pre-empt cities and states from this area? Docket 20018.

There are four more dockets, and comments to all of these dockets are due at the FCC by June the 7th.

You have asked for relief. You have pleaded for help from CATA, NCTA, and your state associations. You have attended FCC Regional Meetings and have begged for help.

Now you have an offer of help from a sympathetic Cable Television Bureau. In the due process and procedure world of the FCC, everything of major importance such as this must go through an official docket phase that allows comments from interested parties. You can be certain that those who would try to stifle or stop cable will comment. And what they will say, in comment, will *not be* what you would say in comment.

Do something positive for yourself. You have asked for help; now take advantage of this helping hand. *Comment today, before June 7th.*

CABLE CAPTIONS

One of the joys in publishing a monthly magazine (we are learning) is the ability to stay flexible enough to deal with pressing issues while they are still timely. Case in point: Towards the end of April the FCC released the first major surgical piece on the cast-in-concrete March 1972 rules. Seven separate rule making proposals are included, running the range from federal pre-emption of technical standards to extending CATV franchise terms to 25 years in certain situations. Comments to the FCC are due by June 7th. The size of the FCC release necessitated that CATJ "bump" a couple of planned-for-June features to get the material into your hands in time to comment. It all begins on page 41 here.

While the **Clarification of Rules and Notice of Proposed Rulemaking** (see above) is the work of many hands at the Cable Bureau; Steve Effros is the guiding hand through the document. Early "readers" of the release were generally pleased with the tone of the contents although a few voiced concern that the Commission was not proposing to go far enough with relief for existing system operators during the upcoming (and critical) franchise renewal negotiations period.

With advance notice that the rules relating to franchise procedures would be changed (and soon) CATA had delayed publication of our initial booklet "Understanding Form 325 and Filing For a Certificate of Compliance". With the issue of the Clarification Docket (see above) we at least know **why** we delayed; but until the rule making dockets are cleared, we will continue to hold off printing **Understanding 325;** there is no point in publishing a guide that becomes outdated in just a matter of a month or two.

Copyright seems to have fallen to a temporary secondary position in many quarters. At Chicago's April NCTA meeting, meeting after meeting (including many special meetings scheduled during the course of the event) allowed operators (large and small) to voice their positions. Most meetings were characterized by heated debate and there was little give and take. Those who wanted to amend the bill (S.1361) locked horns repeatedly with those who wanted to fight for a complete defeat of the bill. Among those joining the "defeat the bill" posture at Chicago was Yolando Barco of Pennsylvania and George Nichols of Iowa, previous supporters of amendments.

One MATV type operator now boasts having 55,000 apartments and condo units under contract for service. He charges monthly CATV-type rates and is dealing directly with apartment complex owners in major metro markets such as Philadelphia, Baltimore and Atlanta. His size, relative to major CATV MSO's, is already comparable although he operates **without** franchises, fees, or technical standards. To date his installations have been current CATV state-of-the-art technology and his service is generally comparable to good quality CATV offerings.

With all price controls off on May the first, operators are finding steel and aluminum related products jumping 15-40%. Hardest hit: strand, lashing wire, pole line hardware, towers and antennas. There is still imported (Japanese)

strand for under $43.00 available but it too will jump price this summer. Operators planning new plants or extensions on their own poles were shocked when poles jumped from under $10.00 to over $20.00. Many are now rescheduling installation to go underground with smaller system plants in rural areas.

Correction — Annual FCC Report Form: Item 7-g-ii(2) (on Page 3) of the FCC cover letter on annual reports to the Commission should be corrected to read "I hereby certify that, to the best of my information, knowledge, and belief, no complaints regarding violations of equal employment provisions of Federal, State, territorial or local law by this cable television employment unit were filed during 1973 with anybody having competent jurisdiction." Don't try to understand it, just correct your own copies and remember to file by June 30th!

A special thanks to CATV manufacturers during a time of increasing costs. Remember when matching transformers were $4.75 each? They are under $.50 now. CATV equipment, outside of the afore mentioned steel and aluminum related hardware items, has stayed very constant while everything else around us has gone up. As an industry, we are fortunate to have so many manufacturers that really try!

Numbers — Total 1973 revenue of 3 national nets plus their 15 owned and operated stations was $1,835,300,000.00. At $60.00 per CATV household per year, that is equal to 30,584,666 cable homes (equivilent revenue). The 15 owned and operated stations had revenues alone of $428,100,000.00, equivilent to 7,133,333 CATV homes at $60.00 per year. CATV has a long way to go!

Commissioner James H. Quello, sworn in April 30th after some battles from anti-broadcast forces (Quello is an ex-broadcaster from Detroit) named Assistant Bureau Chief Allen Cordon of the Cable Television Bureau as his Legal Assistant. Cordon engineered the 1973 round of small system operator meetings, with Sol Schildhause, and is an ardent supporter (and believer in) small town cable.

CATA Asks For Non-Dup Relief: Following a series of meetings with FCC personnel, CATA President Kyle Moore has written FCC Chairman Richard Wiley requesting that all systems with 1500 or fewer subscribers be afforded "interim relief" from non-duplication protection. Noting that the Commission currently has a proposed rule making which is suggesting raising the non-dup system size floor from 500 to 1500, and that during the summer months small systems in particular are troubled by early storm warnings being eliminated from their systems while channels are switched off for non-dup purposes, CATA President Moore asked that the Commission "move swiftly to institute interim rules to lift any non-dup requirements for systems with fewer than 1500 subscribers" at least through the critical stormy months of the summer.

CATA Copyright Position: There seems to be some confusion on the CATA Copyright Position. Simply stated . . . "CATA is opposed to any inclusion of CATV in Senate Bill S.1361; and CATA is also opposed to any Copyright Bill that leaves the question of secondary transmission as it might relate to CATV unanswered. CATA is fighting for a complete elimination of Section 111 (CATV) from the Bill, and a revamping of other sections of the Bill so as to clearly eliminate CATV from copyright liability for all time."

Quote of the Month: From the Clarification of Rules and Notice of Proposed Rulemaking, issued by the FCC. **"Cable television must be allowed to grow in stages or it will be killed by overexpectation and excessive demands."**

NULLIFY CO-CHANNEL WITH ANTENNA SPACING

What Is Co-Channel?

Any form of signal degradation on our system pictures is annoying. Degradation that is widespread throughout the system increases service complaints, increases the work load for the office staff and requires countless home service calls.

Any signal that leaves the head end degraded is certainly going to cause widespread complaints. And aside from noise in the pictures, co-channel interference is probably the most common complaint area.

People who have grown up accustomed to poor quality fringe reception have grown used to co-channel interference. But a town that has had several good channels of off-air reception before the cable went in are not going to understand degraded pictures, and possibly they will not tolerate them. When pictures are poor in quality and subscriber growth halts, top management (which also may not understand or appreciate co-channel interference) suddenly gets very concerned about *your* problems. It is strange how all of the good channels have people lined up taking credit for their sharpness, and how all of the not so good channels are *your* fault!

Co-channel interference is the result of two or more same channel stations appearing at the television receiver at the same time.

The Federal Communications Commission, in the revised allocations table put into effect in 1953, established certain spacing criteria for television stations. This spacing criteria was intended to keep stations on the same channel, or adjacent channels, sufficiently far-apart so as not to cause one another interference within their normal (Grade B contour) viewing areas. Unfortunately many CATV systems operate beyond Grade B service areas, and wayward signals often get into our receiving antenna systems without regard to another signal that is already there.

At the request of the FCC, the television industry in 1956 formed TASO or *Television Allocations Study Organization.* Some of the best minds in the television (and VHF and UHF) industries of that era worked together to develop meaningful real (test) numbers which would provide the FCC with future data to base new channel allocations on.

One of the things that TASO did was establish reception grades and to define what these grades of service mean in everyday language. They appear here. Utilizing various testing techniques, hundreds of viewers were asked to rate test pictures. Pictures were purposely "messed up" with various types of interference, including co-channel *beats.*

PICTURE RATING — DEFINITION

Excellent (TASO Grade 1) — Extremely high quality, as good as you could desire.

Fine (TASO Grade 2) — High quality; enjoyable viewing; interference perceptible.

Passable (TASO Grade 3) — Acceptable quality; interference not objectionable.

Marginal (TASO Grade 4) — Poor quality, you wish you could improve it; interference somewhat objectionable.

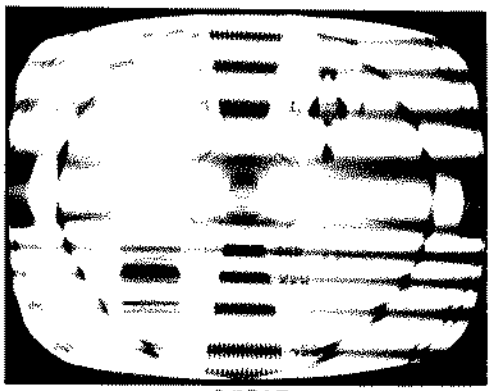
Inferior (TASO Grade 5) — Picture very poor, but you can watch it; interference definitely objectionable.

Unuseable (TASO Grade 6) — Picture so bad you cannot watch it.

Television broadcast transmitters are assigned by the FCC to operating carrier frequencies. However, even for the same *assigned channel* the actual operating frequency varies, by FCC assignment, and for good reason as we shall see.

Stations are generally referred to as plus (+), minus (-) or zero (Ø) offset. This means the station's carrier operating frequency is plus 10 kHz, minus 10 kHz or exactly on the nominal assigned visual carrier frequency. Channel 2's nominal carrier frequency, for example, is 55.250 MHz. A station assigned to a - offset would be assigned to 55.240 MHz (10 kHz below the nominal assignment) while stations assigned to a + offset would be assigned to 55.260 MHz (10 kHz above the nominal assignment).

The FCC, in releasing its allocations table in 1952, recognized that co-channel interference was here to stay. And that this interference could be less objectionable if two adjacent same-channel allocations (i.e. Baltimore and New York City on channel 2) were purposely *offset* in operating frequency.

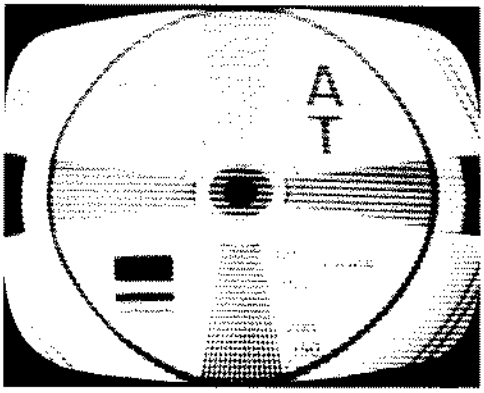


0 BEAT

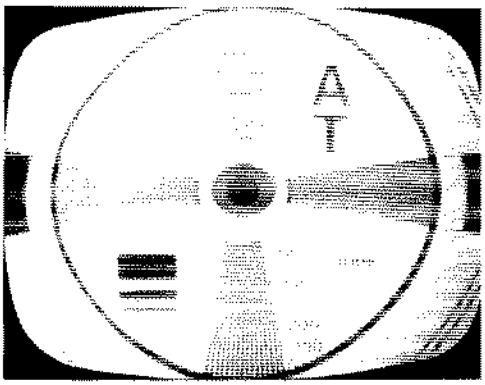
The first photo shows interference created when two stations, operating on the same *nominal* transmitter frequency, are received together at a receiver. The big, wide bands disrupt viewing. *The desired station is 20 db stronger than the undesired station.*

The second photo shows the same 20 db differential, only now the two signals are operating 10 kHz apart, as a 2 zero and 2 + offset pair of carriers might beat. The interference, still present, is not as *objectionable* to the *average* eye.

The third photo now separates the two carriers by 20 kHz, as a 2+ and a 2- (offsets) might beat again, the interference is present, but the degree of degradations is reduced.



10 kHz BEAT



20 kHz BEAT

It is fortunate for CATV that the FCC adopted *offsets* in 1952, because if all stations operated on the same (nominal) assigned frequencies, the wide bands of interference shown in the first picture would be all over the dial in fringe areas.

As it is, the 10 kHz and 20 kHz beats are bad enough. And most areas have been so offset assigned that zero-beat offsets (which can be created by *any two stations operating on the same offset*, whether +, -, or zero) are rare.

Some CATV operators refer to same-offset (zero beat) offset as long distance co-channel. This is a proper assumption in most cases, since stations assigned to the same offset (whether +, -, or zero offset) are seldom near to one another.

Returning now to the TASO results (1), we find that even within the +, -, and Ø offset assignments, there are critical regions where precise offsets create much worse screen-pictures than others just a few hun-

dred cycles away.

For example, stations are required to maintain a transmitter output frequency of +/-1kHz at VHF and UHF. Thus 55.240 (channel 2 minus) can vary from 55.239 to 55.241 MHz and still be "legal".

So *two* stations operating on 2- (55.240) could move around as far as 2 kHz (55.241/55.239) apart and produce a beat that would not necessarily look like two stations on the same offset. A 2 kHz beat is shown here. This can happen at +, -, or zero offset, anytime two stations have drifted apart by as much as the law allows, one going down and one going up simultaneously.

As the TASO study indicates, two stations that happen to fall precisely 360 cycles apart (in operating frequency) had 50% of the test viewers rate the picture quality as TASO Grade Fine (2) when the ratio between the two carriers was only 25 db. But let the two transmitters drift apart so that the difference in their frequency was 604 cycles, and the ratio between the two carriers had to be 49 db before 50% of the test viewers rated the picture TASO Grade Fine (2).

And while TV transmitters are fine instruments, they do move around a little bit from time to time; a 244 cycle drift (604-360 cps) is not very much at channel 13 (or 31!). And the CATV system with co-channel problems can be blamed for a problem that rightfully belongs to one (or another) drifting TV transmitter. Co-channel that comes and goes may *not* be entirely a function of weather conditions. If two transmitters drift into the just-right offset pattern, the co-channel degradation on two stations assigned to the same offset frequency can increase by as much as 24 db, and that is a bunch.

The same thing can happen at 10 kHz and 20 kHz offsets as is noted here. There are some offset beat separations which are *deadly* to the viewer.

There isn't much that the CATV system can do if the relative carrier levels stay the same (between desired and undesired signals) or nearly the same, but the transmitter frequency tolerances shift (or drift) into these deadly beat offset regions. However, knowing what is happening may at least save a hurried trip to the head end (or up the tower) to check on what happened to your precise horizontal spacing between your antenna arrays.

DEADLY OFFSETS VS. GOOD OFFSETS

Taso tests revealed that within the 0, + and - offset regions there are good and bad regions where viewer reaction to degraded pictures becomes either much worse or much better, even when the signal level ratio between the two carriers *remain constant.*

Zero (no carrier) Offset

Worst — 604 cps
Best — 340 cps

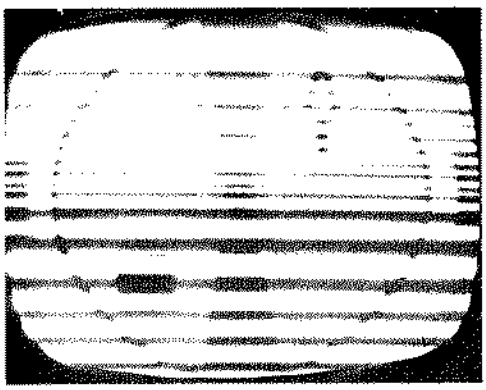
10 kHz Offset

Worst — 9985 cps
Best — 10010 cps

20 kHz Offset

Worst — 19995 cps
Best — 20020 cps

These TASO findings are for color frame rates of 29.97 frames per second.



2 kHz BEAT

Antenna Phasing

When two (or more) antennas are stacked together, they are so arranged that the signal voltages from one adds in phase with the signal voltages developed across the other (or others). Stacking gain is possible because two identical antennas *each located the same distance* from the transmitter source as the

(1 — Published in Proceedings of the IRE, June 1960)

other(s) receive signals in the *same phase relationship.* And if the signal voltages appearing at the antenna terminals of each antenna in the array are *in phase,* then it is a simple matter to add them together, still in phase, by carrying each in phase antenna signal voltage to a common point through equal lengths of coaxial cable.

The exact phase (represented mathematically in degrees) is unimportant, as long as each antenna is in phase with all other antennas in the array.

If one or more antennas are purposely (or accidentally) place out of phase with other antennas in the array, signals do not *add* together (i.e. the sum voltage is *not* the total of all voltages present).

One way to place antennas out of phase with one another is to so locate the antennas in space so that the signal must travel a greater distance to one antenna than to the other. See diagram.

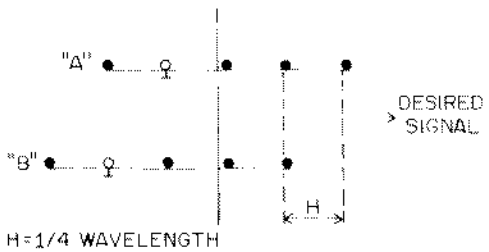


DIAGRAM ONE

Look closely at the diagram. The desired signal approaches both antennas; only it is intercepted by antenna "A" ¼ wavelength before it is intercepted by antenna "B". At the output terminals of antenna "B", the signal is therefore 90 degrees (360 divided by 4) *behind* the signal output of antenna "A". In effect, it is out of phase, and cancellation will take place.

Refer to the next diagram. The two antennas are now stacked together electrically

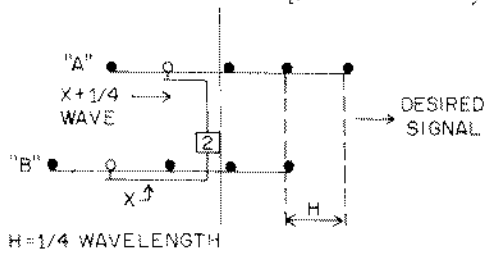


DIAGRAM TWO

with two lengths of coaxial cable. The cable that connects the "A" antenna to the hybird mixer is electrically ¼ wavelength longer than the cable that attaches the "B" antenna to the mixer.

The net result is as follows:

(1) A signal from the forward direction desired station arrives at the "A" antenna ¼ wavelength or 90 (phase) degrees before it arrives at antenna "B".

(2) However, before the signal gets to the hybird mixer, it goes through a piece of coax that is electrically ¼ wavelength longer than the cable connecting the "B" antenna to the hybird mixer.

(3) Net result, it gains 90 degrees by the antenna location, but it loses 90 degrees in the cable, so both antennas "A" and "B" are back in phase again at the hybird mixer.

So far this is a meaningless exercise in speeding up and slowing down signal transmission.

But suppose we have, in addition to the desired signal that comes at the front of the antennas, an undesired same channel signal (or adjacent channel signal) that comes from the rear of the antennas.

The forward direction signal is in phase at the hybird mixer. But a signal coming to the antennas from the rear has a different path to follow. It arrives at "B" antenna first and is promptly dumped into the hybrid mixer. However, it arrives at antenna "A" ¼ wave (or 90 degrees in phase) later, and also has to go through ¼ wave (or 90 degrees more in phase) of extra cable, before it gets to the hybrid mixer.

The net result is that it is 180 degrees *out of phase* with itself, and it phase cancels. The two signals, on antennas "A" and "B", from the off-the-back undesired station, are equal but opposite in phase, and they cancel.

And this leaves you with the desired station signal only.

This technique has been utilized by CATV system head ends for many years as an inexpensive means of reducing rear-of-antenna co-channel interference. The appropriate data for incorporating this into your own system is included in this article. Note that *any type of antenna system* can employ this approach, whether they be logs, yagis, parabolic dishes or dipoles. However, *each*

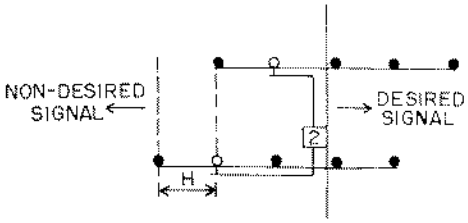


DIAGRAM THREE

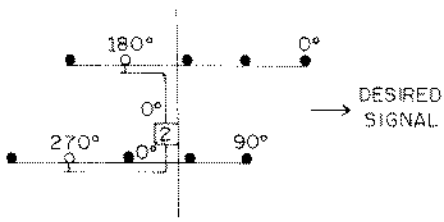


DIAGRAM FOUR

INCREASED REAR-OF-ANTENNA REJECTION

Antenna "A" is in front of the "B" antenna by ¼ wavelength in free space, *on the channel* you wish to cancel. If the channel (signal) is a co-channel source, it is the same channel as you are trying to receive. If it is an adjacent channel source, the spacing is the channel of the adjacent channel.

Antenna "A" is usually mounted to the support mast utilizing the standard boom to mast brackets, in the location recommended by the antenna manufacturer. Antenna "B" has the boom to mast brackets moved so that they are the distance *forward* of their normal mounting position that corresponds to the distance given below for the channel you wish to null (i.e. same channel or adjacent channel). This places antenna "B" ¼ wavelength behind antenna "A" for the desired (forward direction) signal.

The coaxial stacking lines can be *any length*, except that line A-1 *must* be ¼ wavelength longer electrically than line B-1. The electrical length of a piece of coaxial cable (RG-59A/U or RG-11A/U) is *less* than a free space ¼ wavelength. Electromagnetic waves (fields) travel more slowly in material dielectrics than in space (or air), and one complete 360 degree cycle (a wavelength) is shorter within a dielectric.

The table given here is for cables with a *velocity factor* of .66, or RG-59A/U. Do *not assume* any hunk of 59 or 11 that you may have around the shop is automatically .66 velocity factor cable. If you guess wrong, the extra ¼ wavelength (line A-1 below) will be something other than a ¼ wavelength and your whole system will be off.

This system is actually designed for same channel (co-channel) rejection. However, it *can* be used (with some sacrifices) for rear rejection of an adjacent channel signal. If you can achieve additional rear channel rejection of 20 db, while sacrificing approximately 3 db of desired channel signal, it may be worth some additional desired signal loss.

The ¼ wave antenna offset spacing and the additional line length of coaxial line "A-1" is based upon a certain channel. If you desire channel 2, and want to knock down channel 3, the ¼ wave antenna offset and extra line length for "A-1" *should be channel 3*. This will insure maximum cancellation of 3, while degrading the forward signal on channel 2 by approximately 3 db.

Of course with same channel (co-channel) rejection the extra (second) stack nets you the usual 2.5 db stacking gain in the forward rejection and there is no desired signal loss by using this technique.

Channel	*¼ Wave Space*	*¼ Wave Coax*	*Channel*	*¼ Wave Space*	*¼ Wave Coax*
2	51.7"	34.1"	8	16.1"	10.6"
3	46.8"	30.9"	9	15.6"	10.3"
4	42.7"	28.2"	10	15.1"	9.9"
5	37.3"	24.6"	11	14.6"	9.6"
6	34.7"	22.9"	12	14.2"	9.4"
7	16.6"	11.0"	13	13.8"	9.1"

antenna must be exactly identical (i.e. use two antennas of the same brand and model) to maintain phase relationships.

This procedure will work best for signals that are (more or less) 180 compass degrees apart (i.e. one signal north or zero degrees and one signal south or 180 degrees) because the antenna elements remain linear with respect to the wavefronts in this situation.

However, it can be employed with lesser success for signals that are as much as 10-15 degrees off of a 180 degree compass bearing differential (i.e. if the heading to the desired station is called zero degrees and the undesired signal is from 165 to 195 degrees off of that heading).

Horizontal Antenna Spacing

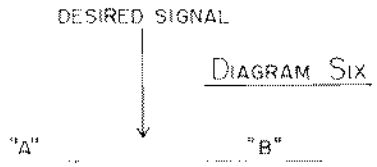


DIAGRAM SIX

The principle established that antennas can be so located as to purposefully introduce free-space phase delays in the arrival of signal at antennas "A" and "B". Look now at a more common problem: co-channel from a source more or less off of the front of the antenna array, but not in line with the desired signal.

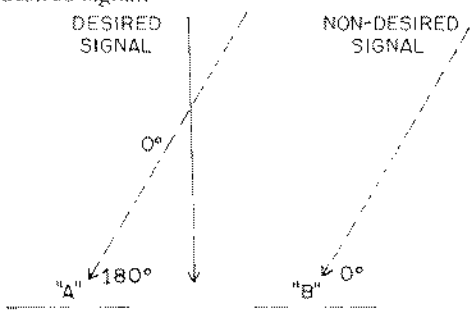


DIAGRAM SEVEN

In this diagram, the desired signal arrives at antenna "A" and antenna "B" at the same point in time. Or, it is in phase at both antennas.

However, the undesired signal arrives at antenna "A" 180 degrees (in phase, or ½ wavelength) later than it arrives at antenna "B". It is therefore out of phase between "A" and "B" and it will self cancel, at the hybird mixer.

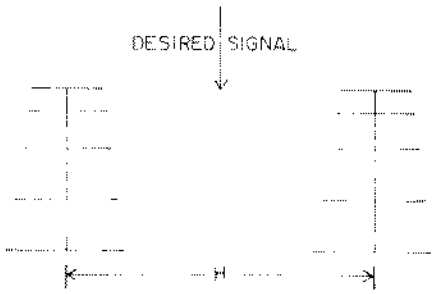


DIAGRAM EIGHT

The key is finding a horizontal distance (H) between antennas "A" and "B" so that the ½ wavelength (180 degree phase delay) is maintained. The distance does not have to be ½ wavelength, it can be any multiple of ½ wavelength that gives us 180 degree phase delay. Which is to say it may be ½ wavelength, 1.5 wavelengths, and so on. The required number of wavelengths for 180 degree phase maintenance is always a number that divides by .50 and gives an odd number; .50 divided by .50 is 1. On the other hand 1.0 (wavelength) divided by .50 is 2, an even number that connotes not 180 but 360 degree phase change. And since phase starts at 0, works through to 360, and then starts at 0 again, 0 and 360 are essentially the same number and we have merely gone back *into phase* again.

This co-channel nulling or phasing process works exactly like our rear-rejection system, except that our phase delay is all in free space. We do not depend upon additional phase delay in a length of coax.

One of the more common mistakes with this type of system is when someone tries to go *more than two antennas wide* (i.e. horizontal two stack array).

If the spacing along the horizontal axis is correct, and the two antennas are combined with identical lengths of coaxial cable to a hybrid mixer, everything works out fine.

But, if four antennas are placed side by side, the problem becomes more complicated.

The antennas are some physical distance apart, determined by the free space distance required for the (1) angle of arrival of the undesired signal, and (2) the operating frequency (wavelength) of the signal.

The actual distance is fixed by formula, as is the 180 degree delay in the path length between *any two* combined antennas.

Because we utilize horizontal spacing between bays to obtain the necessary *free-space delay* to achieve a 180 degree *phase lag* (and therefore cancellation) system engineers may erroneously assume that when they need more gain, four in a line is going to be better than two.

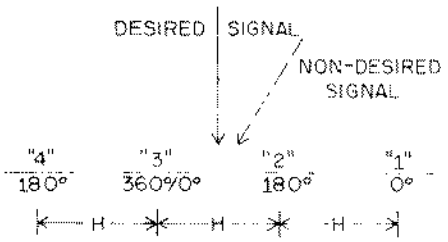


DIAGRAM NINE

Four in a line, spaced so that there is 180 degree phase delay from antenna to antenna might look like this: From antenna 1 to antenna 2 we have 180 degrees of delay. From antenna 2 to antenna 3 we have another 180 degree phase delay. And from antenna 3 to 4, 180 degrees.

But you also have a number of other combinations of delay. For example, from antenna 1 to antenna 3 you have 360 degrees of delay, which is a complete phase cycle. And rather than cancel, antennas 1 and 3 add. The same applies to the 360 degree relationship between antennas 2 and 4.

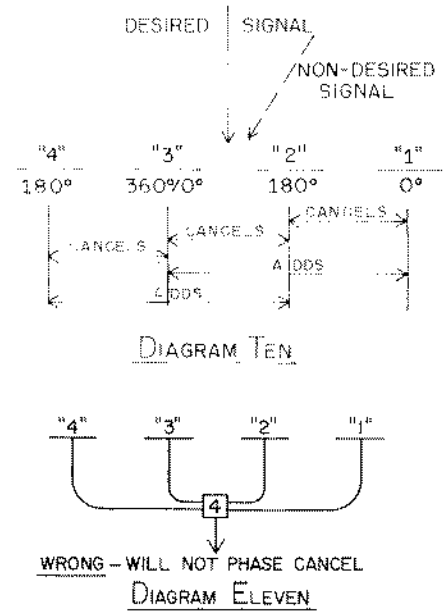
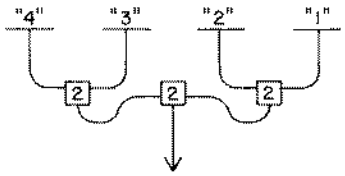


DIAGRAM TEN

WRONG – WILL NOT PHASE CANCEL

DIAGRAM ELEVEN

So actually our null, achieved with *two antennas*, is about as much null as we can expect to achieve in *real performance*. But if two bays (of any antenna) *are not sufficient forward gain* for our problem channel, how do you go about stacking antennas?



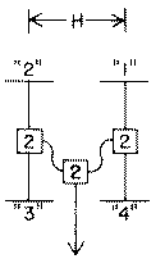
RIGHT – WILL THEORETICALLY PHASE CANCEL

DIAGRAM TWELVE

You *can* stack four (antennas) wide, but it gets very tricky.

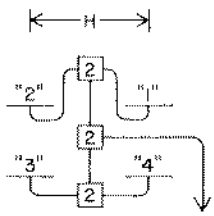
Remember that the *horizontal spacing* between two antennas, based upon a formula that establishes distance "H" as the amount required to create a 180 degree phase lag, is the criteria for nulling.

Therefore antennas can be stacked in a *vertical configuration* and combined in a vertical array, without upsetting the phase relationship.



RIGHT – WILL CANCEL

DIAGRAM THIRTEEN



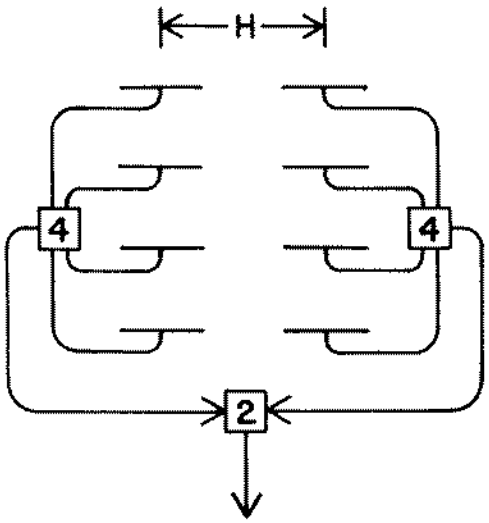
RIGHT – WILL CANCEL

DIAGRAM FOURTEEN

If a four stack array is the size array required for adequate forward gain on the desired station, an array two high by two wide accomplishes the objective. The two sets of vertical antennas are each combined as sets of two, while the horizontal separation between the two sets of two bay vertical arrays is the distance "H" required for phase delay (180 degrees).

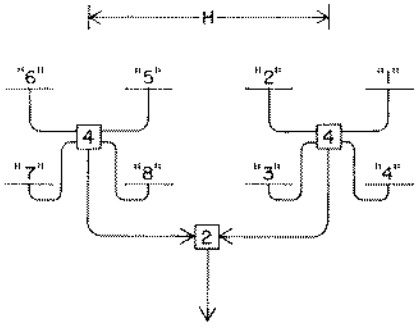
If an eight bay array is the gain-size required, the eight bays are broken down into two sets of vertically stacked four bay

arrays; the distance "H" is still the distance required to obtain the required phase delay.



RIGHT — WILL CANCEL

Stacking arrays wider than two antennas horizontally is tricky, even when precise co-channel elimination is not the objective. This is especially true of yagi antennas, which tend to have many minor lobes in the horizontal plane. And these *minor lobes tend to add and cancel randomly*, apart from the additive effects you are attempting to achieve on the *main* lobes. Consequently yagi arrays more than two wide tend to have pattern discontinuities that may be difficult (or impossible) to predict in advance.(*)



RIGHT — WILL THEORECTICALLY CANCEL

DIAGRAM SIXTEEN

(*—Stacking of yagis and logs for gain and pattern shaping will be the subject of a later CATJ feature.)

Degree of Nulling Cancellation

How many db can you reject an undesired signal utilizing the two techniques outlined here?

The difference between theoretical and practical is often great. On "paper", you can get *complete* cancellation of a undesired signal. In practice, you may get 10-15-20 db *more* than you would achieve with a single antenna or stacked array that is *only* concerned with maximum *forward gain.*

The problem in *practice* is mainly that of (1) inaccuracies in the installation, and (2) propagation abnormalities between the transmitter and the receiving site.

Propagation abnormalities are beyond your control. Most textbooks assume the signal path is a straight line from the transmitter to the receiving site. Within the *visual* horizon area, this may be true. Within the *radio* horizon region (where signal diffraction takes place in the lower atmosphere) this is less true. In the scatter region, this is seldom true.

Far radio-horizon region signals and scatter region (anything beyond the regular Grade B contours) signals reach the receiving antenna over more than a single path. Signals that may penetrate several thousand feet into the atmosphere along the path are returned to the receiving antenna after being "bent" in the atmosphere and redirected back to earth.

Consequently, the *inbound phase* of the *wavefront itself is constantly changing*, and constantly going in and out of phase along its own trajectory at any stationary point (such as the antenna location).

You can recognize this in/out of phase on the distant co-channel source signal when it seems to "flash" up many db (in interference level) and then disappear as quickly as it appeared. Many a CATV tech has climbed a tower looking for a loose fitting on an antenna, phasing line, or mixer when this happens. And he comes back down twice as mystified because while the undesired co-channel seems to be "flashing" the desired signal level seems normal.

Even with these problems, proper antenna system design for co-channel rejection (if not elimination) is worthwhile. Ten db of additional rejection is not to be winked at, and 20 db is a worthwhile goal in anyone's book.

Plot the direct bearing to the desired station transmitter, preferably drawing a straight edge line from your receiving location to the transmitter location. Plot the direct bearing from your receiving location to the undesired transmitter source. Use a compass and measure (or calculate) the angular difference between the two headings. If one heading is 10 degrees true (from north) and the second is 40 degrees true, the angular difference is 30 degrees.

Go to Table One below and find the distance in inches for one free space wavelength on the channel. Go to the chart below and find the antenna spacing (H) for maximum nulling (cancellation) for the angular difference previously computed.

For example:

(1) Angular difference is 25 degrees, between beam headings for the desired station signal and the undesired station signal.
(2) The channel is 8; Table One shows the free space wavelength to be 65.2 inches
(3) The chart below shows 25 degree angular difference requires 1.22 wavelength horizontal separation (distance H) for cancellation.
(4) Distance H therefore equals 65.2 inches x 1.22, or 79.54 inches horizontal spacing.

Note that on the chart that angular difference spacings repeat in 90 degree increments, and that there is an abrupt break at 40 (140, 220, 320) degrees to compensate for very close spaced (or very long spaced) distances.

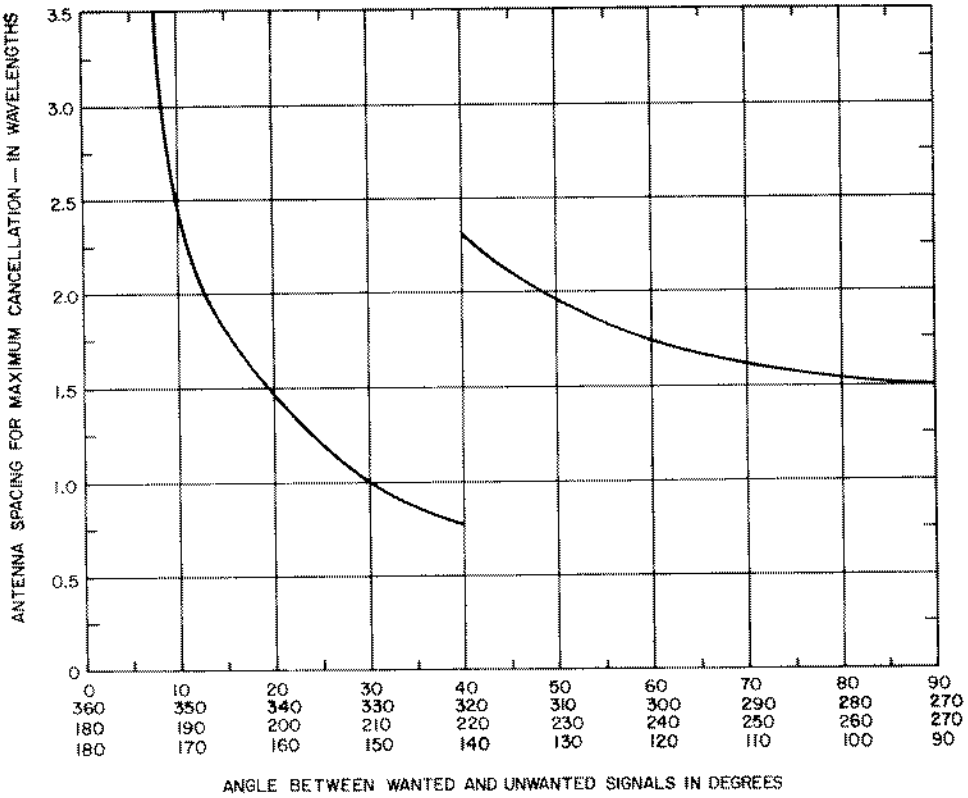


Table One

Channel	*1 Wave Space*
2	214.6"
3	193.5"
4	176.2"
5	153.3"
6	142.2"
7	67.5"
8	65.2"
9	63.1"
10	61.2"
11	59.3"
12	57.6"
13	55.9"

NOTE: One wavelength in space has been computed based upon visual carrier frequency, not center frequency of channel. This is to compensate for the video carrier beat that produces offset patterns on the screen.

THANK THOSE WHO DO . . . QUIZ THOSE WHO DO NOT . . .

The small (but growing) CATJ staff has concentrated to date on putting together an effective, worthwhile publication. Our efforts to get advertising support have been minimal; we do not as yet even have an advertising sales person. With advertising support CATJ will be able to devote more pages per month to worthwhile technical features. *You can help.* Point out CATJ to your equipment suppliers. Thank those who do support CATJ. Ask those who do not to consider it. CATJ is your kind of magazine!

CHANNEL COMMANDER

I

Before Jerrold introduced the Channel Commander I, the CATV industry processed head end off-the-air signals via either (1) on channel strip amplifiers, or (2) demod and remod units.

The Channel Commander I brought a new signal processing option to CATV system operators; *hetrodyne signal processing*.

Hetrodyne signal processing is as old as the first introduction of the super-het circuit in radio receivers; circa 1930.

Basically it works in this manner:

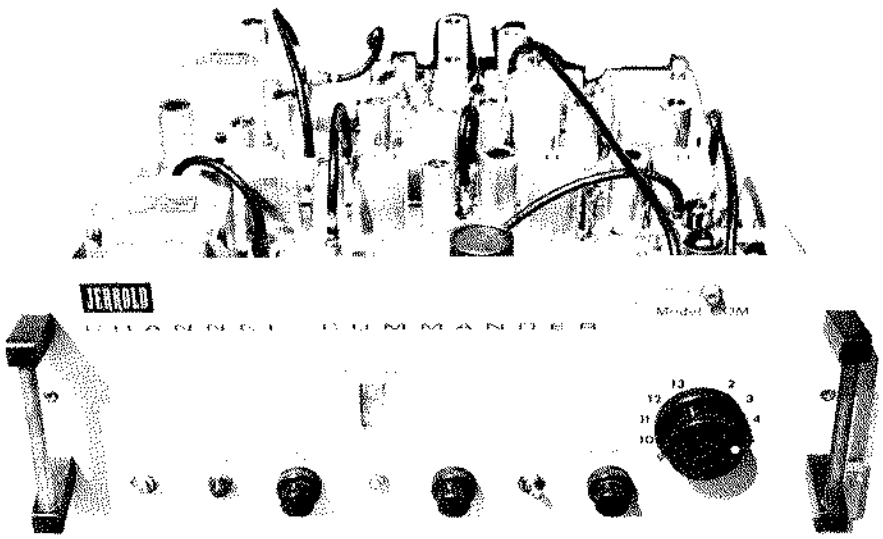
(1) An RF (radio frequency) signal is fed into the receiver unit, where it is amplified (boosted) at its incoming frequency.

(2) The incoming RF signal is frequency converted to a *lower* standardized frequency called an IF (intermediate frequency). This conversion of the incoming frequency takes place in a stage called a *mixer*; where the incoming signal (frequency) is *mixed* with another internally generated signal (frequency) and after the two frequencies "mix" the sum (arithmetic) or difference of the two frequencies is the IF.

(3) The IF (intermediate frequency) is processed through gain (amplifier) stages where the signal is further boosted, and automatic gain control (AGC) is applied to the signal to eliminate or control fading and flutter.

(4) Separate IF amplification, AGC, and filtering take place on the visual (picture) and aural (sound) portions of the signal. This is done by separating the visual portion of the TV channel and the aural portion in a filtering network, and thereafter treating each portion separately.

(5) The IF processed signals (visual and aural) are then re-combined into a composite signal and fed into a second *mixer*



stage which mixes them back *up* in frequency from the IF to either the original RF input channel, or some other channel selected by the system operator.

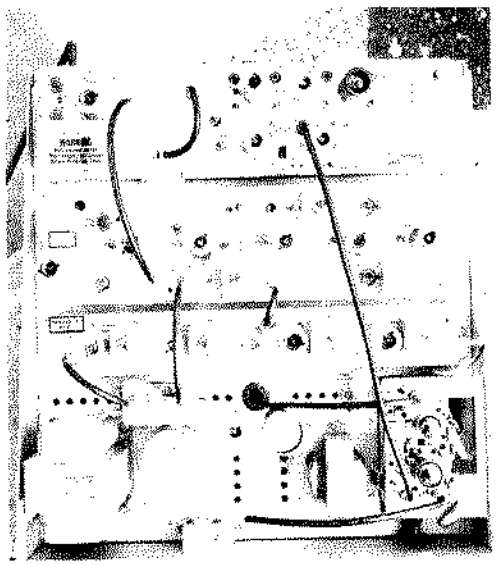
There are of course a few options to the basic package. One is a circuit that kills (shuts off) the output signal when the input signal either fades out or leaves the air. This prevents the noise of the Commander (and any pre-amp before it) from appearing on the system in the absence of real signal.

Another is a *standby carrier* which, in the absence of an input signal, switches on the visual carrier frequency of the output channel of the Commander. The purpose of this is to insure that the CATV plant always has "carriers" on the plant, regardless of whether stations are being received or not. This in turn relates to CATV plant AGC systems which "sense" the presence of carriers on the CATV plant, and use these carriers as a reference for AGC of the CATV trunk and distribution (line) amplifiers.

The Channel Commander I was the first of its kind, although it has been subsequently followed to the market place by many competitive units. And the Commander I has also been superceded by the Channel Commander II, a solid state unit of more recent design.

The fact that the Commander I is a tube type of unit brings us to the need for this servicing article. Any tube unit requires occasional attention, and when tubes get changed (routinely or due to failure in service) some realignment is required.

Because the unit is fairly complex, system techs charged with keeping them in shape often "freeze" at the thought of digging into the unit. We hope to show you that if you



follow the procedures outlined here, you have nothing to be afraid of in alignment.

A word of caution however: Misalignment is a characteristic of most Commander I's now in service. When *properly aligned*, the unit produces fine quality pictures and reasonably good color. But there are many (well, a couple anyhow) mistakes in alignment which if they happen will smear the color, with fringing or wash out, smear the black and white (detail or definition) portions of the picture, and make the sound carrier control level all but inoperative.

The general functions of the Commander I modules are described separately in this article.

Alignment Procedures

Certain pieces of test equipment are re-

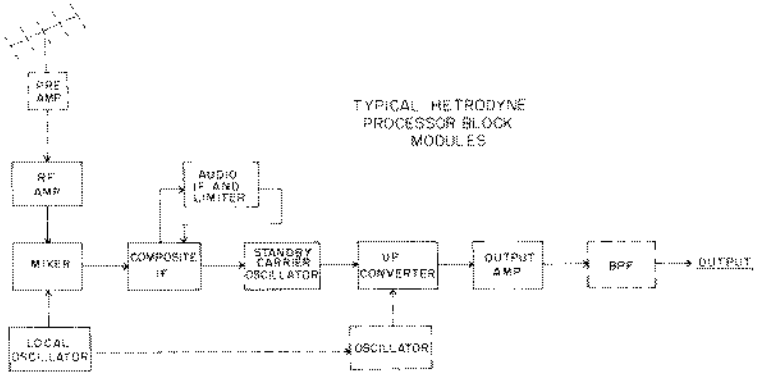


FIGURE ONE

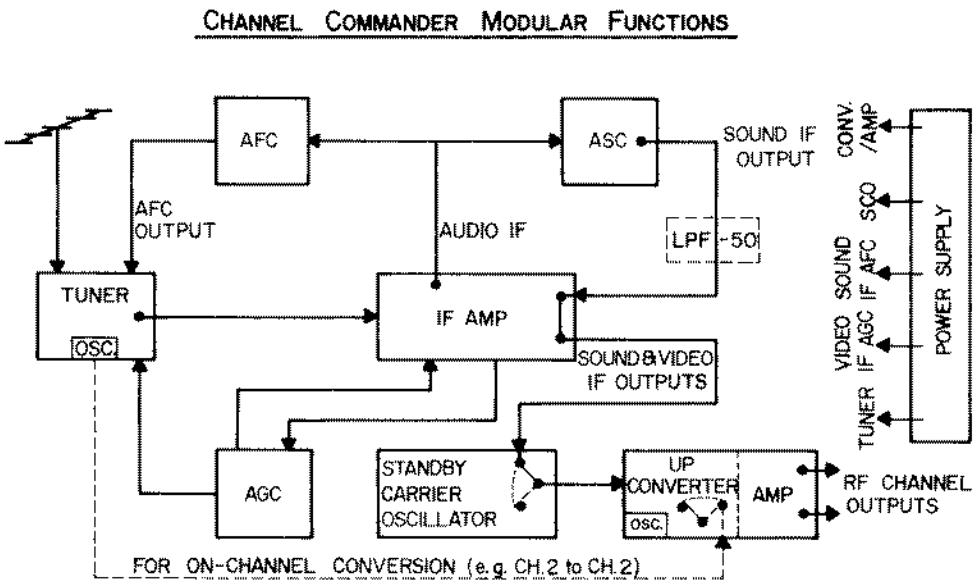


FIGURE TWO

quired. Alignment *cannot* be done by simply watching a field strength meter and TV set connected across the output of the unit. The minimum recommended test equipment is given separately here.

The unit aligned by CATJ in preparation for this report was "borrowed" from a CATV system here in the Midwest. The unit was in service, but the users were *certain* the alignment was up to par. We found otherwise, with serious color and sound problems, as we shall show you.

See Figure 3 here. Set up your test equipment and the Commander I as shown.

(1) Set the power switch on front panel to *on* and allow 5 minutes for warm-up.

(2) Set AFC ON switch to the off (down) position; set GAIN SELECT switch to MAN position.

(3) Tune sweep generator to the mid-

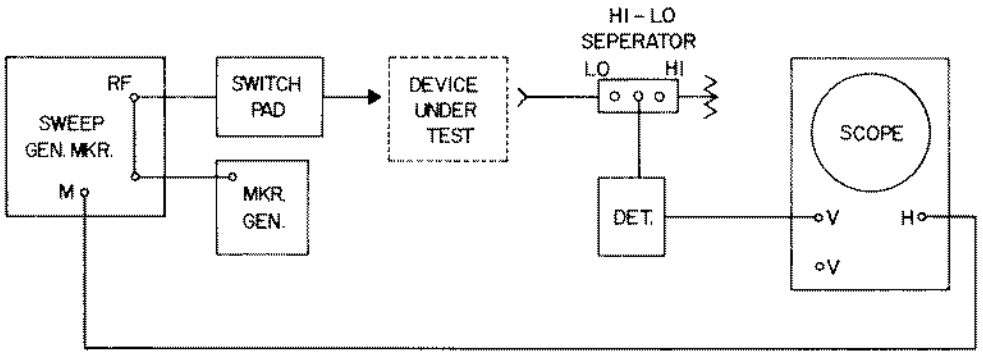
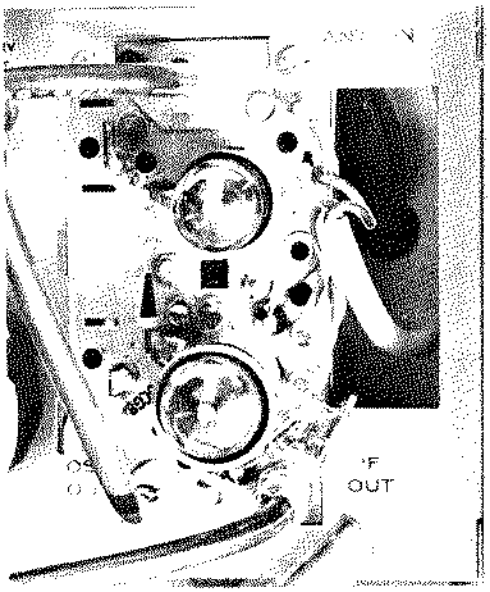


FIGURE 3 - TEST SET UP



frequency of the input channel; set sweep for sweep width of at least 20 MHz (to maintain linear sweep). Set marker generator (WR-99 or equivilent) with markers on the desired channel visual and aural carriers.

(4) Observe the scope screen display for flatness and bandpass; adjust C12 and C13 (on the tuner module) for flat display (+/- 0.5 db) with video and sound carrier markers at the top (*flat*) portion of the display.

(5) If the Commander I is to be used only on a single *input channel*, the tuner can be peaked with much improved single channel response than if you attempt to compromise the tuner adjustment for all 12 channels of operation.

(6) Open up the *bottom* of the tuner module. Notice that each channel has an individual strip on the tuner. There are four coil windings on each strip.

The first winding (towards the rear of the tuner module) is the RF input coil. The second and third coils are the inter-stage tuning coils and the fourth (closest to the front of the module) is the local oscillator coil.

(7) By adjusting C12, C13 and C16 (located at the back of the tuner), and using a plastic tuning tool moving the windings on the two inter-stage coils, you can optimize the response of the tuner on the single channel. Spread the two inter-stage coils, and push them closer together while observing the sweep display on the scope. You should be able to achieve an in channel flatness of +/- 0.25 db and a vastly improved input match (14-16 db is good after this optimizing procedure).

(8) If after some tuning and attempts to get a flat response you are not satisfied with the results, try physically swapping the plug in channel strip on the tuner with one of the two adjacent channel tuner strips. (i.e. If you are working on channel 8, swap with the channel 7 or 9 four coil strip in the tuner.)

(9) In some cases the local oscillator will not adjust properly (fine tuning control). The answer is to work with spacing on the fourth coil (nearest front of tuner) in the same manner described above.

(10) Finally, when you have the tuner looking like you want it, coat the four coils with Q-dope or clear finger nail polish to fix the coil windings in place (thereby reducing tuner alignment drift in further operation).

Alignment-Video IF

(1) With the unit turned off, set up the alignment procedure shown in Figure 3.

(2) Place tube jig (*) over tube V304 (6DC6) in video IF module.

(3) Connect a 6 db in-line pad to J303 and terminate J304 with a 75 ohm terminating fitting. Connect sweep signal to the fitting on the tube jig. Connect input to hi-lo splitter to the 6 db pad.

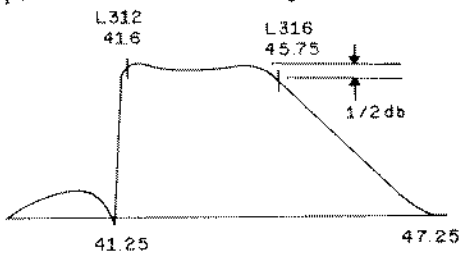
(4) With *no power applied* to the Commander I adjust L317 and L318 for maximum flatness between 41 and 47 MHz.

(5) Now turn on the unit and allow 5 minute warm up time.

(6) Move the tube jig from V304 to V303 (6CB6). Set GAIN SELECT switch to MAN position and set MAN gain control to the maximum counterclockwise position (minimum).

(7) Adjust T304 and R316 for maximum attenuation at 41.25 MHz (this is sound trapping in video IF).

(8) Adjust L312, L315 and L316 for the response curve shown in Diagram 1.



RESPONSE CURVE
(L312, 315 AND 316 ADJUSTMENT)
DIAGRAM ONE

(9) Connect VTVM to test point TP301 and adjust the MANual gain control for a reading of -3.0 volts.

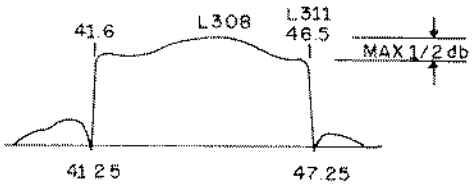
(10) Transfer the tube jig from V303 to V302 (6CB6). Adjust T303 for maximum trapping (attenuation) at 47.25 MHz. *Be sure this trap is on the correct trapping frequency* before moving on.

Alignment Equipment Required

(1) Sweep Generator with flatness +/- 0.25 db within the RF range of the desired channel
(2) Oscilliscope adequate for detected sweep displays and with a calibrated vertical amplifier
(3) Detector 75 ohm, with good flatness and match in the 41-47 MHz IF region
(4) Two switchable pad type attenuators with a minimum of 1 db steps and 60 db attenuation capacity
(5) VTVM with high impedance input or quality FET high input impedance VOM
(6) Field Strength Meter (covering input and output channels)
(7) Marker Generator with markers at 39.75 MHz, 41.25 MHz, 41.6 MHz, 45.75 MHz, 46.5 MHz and 47.25 MHz (*)
(8) Marker generator, variable type such as WR-99A by RCA
(9) Hi-low filter (separator)
(10) 6 db in-line pad
(11) Low capacity probe (10:1 divider type)
(12) 75 ohm terminator
(13) Jig Shield (Jerrold Model AJ-106**)
(14) RF Bridge
(15) -3.5 volt bias supply

(*—The CATJ 10 position marker generator described in the May CATJ is adequate for this purpose. All of the markers required are available from CATJ Kits, including the 41.6 and 46.5 MHz which were not mentioned in the May issue article.)

(**—At press time Jerrold had only a handful of these special tube-jig alignment devices in stock. If after checking with Jerrold you cannot locate this required unit, CATJ can possibly locate some on a custom basis for you at $30.00 each. Write **CATJ Kits, 4209 NW 23rd, Oklahoma City, Ok. 73107** requesting data on the Commander I tube jig.)



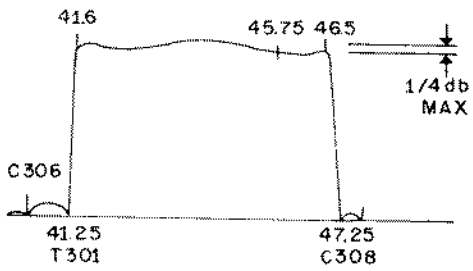
RESPONSE CURVE
(L308 AND 311 ADJUSTMENT)

DIAGRAM TWO

(11) Adjust L308 and L311 for the response curve shown in Diagram 2: recheck the adjustment of T303 for maximum trapping of 47.25 MHz and if you must touch up this adjustment, go back again and adjust L308 and L311 working towards the response curve in Diagram 2. Remove the tube-jig when completed.

(12) Connect sweep input to IF IN terminal J301. Adjust C306 for maximum *attenuation* at 39.75 MHz and C308 for maximum *attenuation* at 47.25 MHz.

(13) This alignment step involves considerable back-and-forth playing between numerous adjustments.



RESPONSE CURVE
(T301 AND 302 AND L307 ADJUSTMENT)

DIAGRAM THREE

See Diagram 3. Adjust T301, T302 and L307 for the response flatness and trapping shown in Diagram 3.

If you are not able to achieve the response curve shown in Diagram 3, it may be necessary to *readjust* other adjustments. NOTE: *Do not* adjust L301, L302, L303 in the IF input stage or L317, L318 or L320 in the output stage if touch up is required.

You may have to work on L308, L311, L312, L315, L316 as well as C306 and C308.

This completes alignment of the video IF module.

Alignment-Audio IF

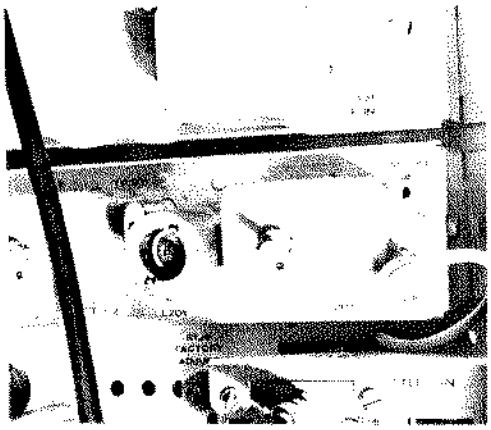
(1) The Commander I is to be turned on and warmed up. Connect a step attenuator to the IF IN terminal J301. Connect a marker generator with 41.25 MHz and 45.75 MHz capability to the step attenuator.

(2) Connect a field strength meter to one of the RF OUT fittings on the rear apron.

(3) Turn SOUND LEVEL control to *maximum clockwise*.

(4) Tune the FSM for maximum indication of sound carrier level on the Commander output channel. Keep the input to J301 down to a level where limiting (*) does not occur.

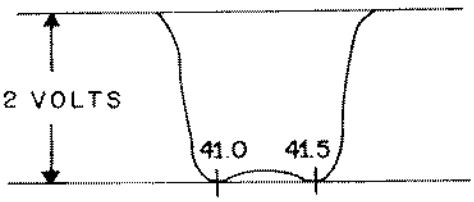
(5) Adjust T203 and T204 for *maximum output level* on the aural carrier frequency. Then turn the SOUND LEVEL control maximum *counter clockwise* and adjust T304 and R316 on the *video IF AGC module* for maximum attenuation of the sound carrier.



(6) Connect a VTVM to test point TP201 on the *sound IF AFC module* and adjust L201 for *maximum negative* voltage. Then back up the adjustment of L201 one half turn counterclockwise and leave it there.

(7) Disconnect VTVM from TP201; connect a low capacity probe in its place; connect the opposite end of the probe via a detector to an oscilloscope.

(8) Insert sweep generator between the marker generator and the step attenuator (see Figure 4) and set the sweep range to cover 40.5 MHz to 42 MHz.



RESPONSE CURVE
(C221 AND T202 ADJUSTMENT)

DIAGRAM FOUR

(9) Adjust C221 and top *and* bottom of T202 for response curve shown in Diagram 4. Keep the sweep input to a level so as to maintain a 2.0 volt deflection on the scope. The flat portion of the curve (41.0 to 41.5 MHz) should not vary more than 0.2 volts (1 db).

(10) Disconnect probe from TP201 and remove the detector. Connect the probe directly from audio output terminal J201 to the oscilloscope.

(11) Adjust the top *and* bottom of T201 for the response curve shown in Diagram 5. Adjust for maximum amplitude *with* equal displacement above and below the base line.

This completes alignment of the Audio IF module.

Clipping Level Alignment

(1) Allow normal five minute warm-up period; set channel selector to proper input

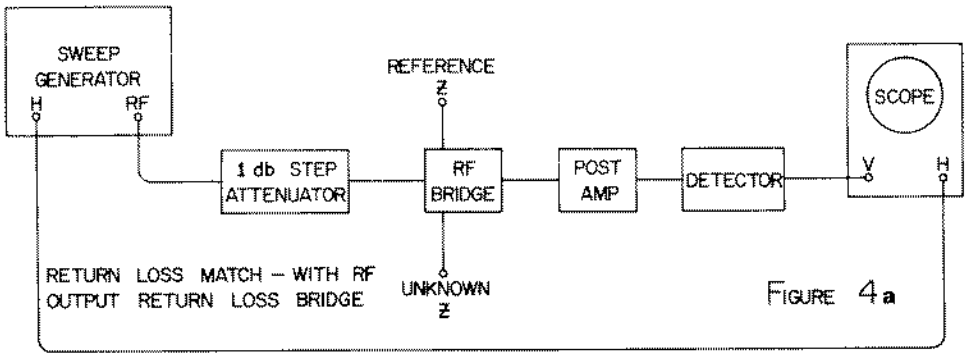
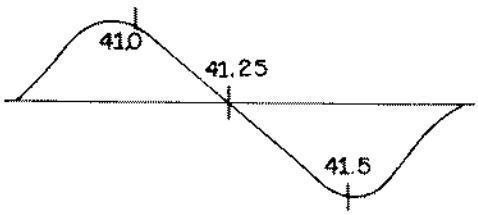


FIGURE 4a



RESPONSE CURVE
(T201 ADJUSTMENT)

DIAGRAM FIVE

channel.

(2) Connect an FSM to one of the RF OUT terminals and terminate the other with a 75 ohm terminator.

(3) Tune FSM to the video carrier frequency of the output channel; set GAIN SELECT switch to AGC and adjust AGC pot for +57 dbmv output.

(4) Connect oscilloscope to TP302 and *loosen* the locking nut on clipping level control R338. Adjust R338 until the sync tips just begin to compress on the scope display. Note the level on the FSM (visual carrier) and back off R338 2.0 db in level.

(5) Reset AGC pot for +57 dbmv output and tighten the locking nut on R338.

This completes alignment of the clipping level adjustment.

Standby Carrier Alignment

(1) Allow *one hour* warm-up time and place unit on desired input channel.

(2) Connect FSM to one of the RF OUT terminals and terminate the other with a 75 ohm terminator.

(3) Turn OSC LEVEL control *maximum clockwise*. Disconnect antenna. SIGNAL OFF indicator light should light up after approximately 20 seconds.

(5) If the time interval is too short, adjust SEN (sensitivity) control slightly *clockwise* and repeat the test.

(6) If the time interval is too long, adjust SEN (sensitivity) control slightly *counterclockwise* and repeat the test.

(7) Adjust L401 for maximum output reading on FSM. L401 will have one side of the peaked response where the peak is gradual, and another side where the peaking is abrupt. Back off from the peak 2.0 db on the gradual (or slow) side.

(8) Adjust OSC LEVEL control for +57 dbmv output.

This completes alignment of the standby carrier timing and level.

The remaining portion to be aligned is the output converter which transforms the IF (processed) signal back to an operating (cable) channel.

While there were numerous modifications to the basic Commander I package during its tenure, the output converter (CCV) experienced more "variations" than any other unit.

In particular, channel 6 was a problem with the Commander I (and many other units). A modified converter / amplifier (Model CCV-6, Series 2) became standard equipment on all channel 6 output units (either on-channel or conversion channels with 6 as the output) *after* June 1965. The primary problem with channel 6 units was the second order (2X harmonic) of the IF amplifier chain which falls into VHF channel 6. Any amplifier has second order products and when they are in as close quarters as the tightly packed Commander I, special engineering is required to keep the second order products from mixing with and beating with the channel 6 output signal from the up converter.

There are many pre-June 1965 Commander I units in service, some of which are on chan-

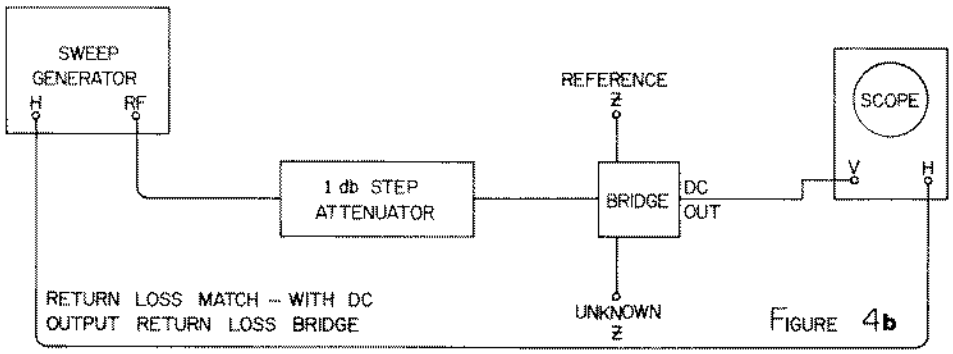


FIGURE 4b

nel 6. These units would have improved color and lower second order beats in the pictures if they were modified with the Series 2 CCV-6 output converter.

CCV Input Match Alignment

(1) Allow normal 5 minutes warm-up time.

(2) Set OSCILLATOR switch to EXT position.

(3) Apply a -3.5 volt bias to feed-through capacitor C512 (located between V503 and L505).

(4) (This may be hard to duplicate but . . .) . . . where the original PIP (plug-in-pad) has been replaced for operations, remove the pad in the socket and replace with the original (or one of the original value) at socket J503.

(5) Set up your test equipment as shown in Figure 4. Connect *the unknown terminal* of the bridge to the IF IN terminal (J502) of the CCV.

(6) Tune the top *and* bottom slugs of L505 for the best input match in the IF band 41 to 47 MHz; you should have a minimum return loss (match) of 20 db.

NOTE: Because the IF system has second and third order output products, it may be difficult or impossible to measure accurately the return loss match *unless* a hi-lo separator is installed as shown in Figure 3 in the output line of the sweep.

CCV Off-Channel Oscillator

When the Commander I is used on the same input and output channel (i.e. 2 in, 2 out) the unit is set up with oscillator switch SW501 in the EXT position. This disconnects B+ voltage from V501 (which may be removed from the module) and OSC IN terminal J501 is connected directly to buffer amplifier V502. The oscillator signal is obtained through a jumper cable from the OSC OUT terminal on the tuner.

This assures the operator that no beat interference will be generated by having the input and output (same channel) oscillators slightly off frequency and producing an offset beat. Because the same oscillator is used for both down and up conversions, the beat is eliminated.

However, for off-channel operation, using the varicap controlled (AFC) oscillator in the tuner for the down conversion to the IF, a separate oscillator is used (V501) for the up conversion to the output channel.

(1) With the -3.5 volt bias (previously described CCV input match alignment) *disconnected*, connect VTVM to C512 (test point between V503 and V504).

(2) Terminate IF IN terminal J502 with 75 ohm terminator.

(3) Set OSCILLATOR switch to INT (internal) poisition.

(4) Adjust L501 for peak reading. *For low band* channels (output) adjust C534 for -3.9 volts; for *high band* channels adjust C503 for 3.9 volts. Reset L501 for a reading of -3.5 volts, going off of the peak of L501 towards the gradual (or slow) side to reduce the reading.

You are adjusting for maximum conversion gain and normally there is a 1 db maximum variation in conversion gain between bias settings of -2.5 and -5.0 volts.

CCV On Channel Oscillator

(1) Follow Steps 1 and 2 for Off-Channel operation.

(2) Interconnect OSC OUT terminal on tuner and OSC IN J501 ON CCV with a coaxial jumper.

(3) Set OSCILLATOR switch to EXT position.

(4) Connect VTVM to C512 (test point between V503 and V504).

(5) Adjust C506 (found behind hole in chassis near J501) for -3.5 volts bias.

Alignment Oscillator Response

(1) Allow normal warm-up period of 5 minutes.

(2) Set up equipment as shown in Figure 3 but eliminate the hi-lo separator.

(3) Terminate *RF OUT 1* terminal J504 with a 75 ohm terminator and set OSCILLATOR switch to INT position.

(4) Attach detector to J505 and adjust L506, L507, L510 and L511 to produce a response as shown in Diagram 6.

The overall IF band of interest is 41 to 47 MHz. The total Commander package shapes the IF bandwidth to 41.25 MHz to 46.25 MHz. The technician has two options here, aligning the CCV to the wider 41.0 to 47.0 MHz spread or to the narrow (same as IF portion) *41.25 to 46.25 MHz spread.*

(5) Remove the 75 ohm terminator from J504 and switch it to J505. Attach detector to J504 and check for response. If the response is tilted more than 0.5 db between 41 (41.25) and 47 (46.25) MHz, adjust for a minimum gain of 17 db / maximum gain of 23 db with flatness correct to within + / - 0.5 db.

(6) On low band (in particular channels 2, 3 and 4) converters, L506 and L507 may have to be detuned slightly to yield the proper re-

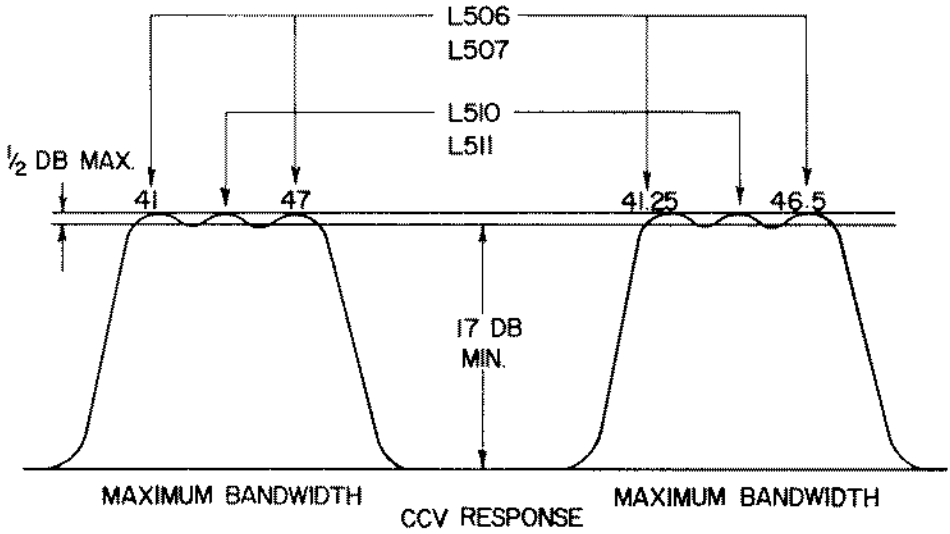


Diagram Six

sponse (C512, coupling capacitor, has a fixed value and its circuit "Q" with L506 / L507 optimizes further up in the band).

(7) On high band (in particular channels 11, 12 and 13) converters, the outer skirts of the bandpass can be slightly improved (made sharper) by *very carefully* adjusting the inductance L509.

NOTE: This is a very critical adjustment and mis-adjustment will destroy the CCV output match. *Increasing* inductance of L509 too far will mis-match the output.

Oscillator Output Match

(1) Allow normal 5 minute warm-up.

(2) Set OSCILLATOR switch to EXT position; terminate one of the RF OUT terminals with a 75 ohm terminator.

(3) Following Figure 4, set up equipment for match response measurements. Attach detector to unterminated RF OUT terminal.

(4) Adjust C521, C522, L512 and L528 to produce a 15 db return loss match across the desired IF bandwidth, and 20 db return loss measurement *outside* of the IF bandwidth.

(5) *Swap* the detector and terminator on the two RF OUT terminals and check for symmetrical response per (4) above. Adjust L512 and L528 if required to make this RF OUT terminal appear as the first terminal appeared.

(6) Recheck response and match with OSCILLATOR switch set to INT and EXT.

This completes alignment of the CCV module.

COMMANDER–I Major Specs

Gain . . . . . .77 db
Sensitivity . . . . . .-20 dbmv for +57 dbmv output
AGC Sensitivity . . . . . .+/-0.5 db output change for input range of -14 dbmv to +36 dbmv
Tuner Noise Figure . . . . . .6 db
IF Response Flatness . . . . . .within ¼ db
Video (IF) Carrier . . . . . .45.75 MHz
Aural (IF) Carrier . . . . . .41.25 MHz
Adjacent Carrier Rejection . . . . . .50 db (in video IF)
IF Output Level . . . . . .+40 dbmv video; +25 dbmv aural
AGC . . . . . .sync tip referenced
Sound IF Limiting . . . . . .10 db limiting minimum at +25 dbmv output with -20 dbmv to tuner input
AFC IF . . . . . .4.473 MHz
CCV Converter/Amp Gain . . . . .17 db
Minimum Output . . . . . .+43 dbmv
Maximum Output . . . . . .+57 dbmv

Commander–I Tube Line-up

Tuner—

V1 . . . . . .6GK5 (RF amp)
V2 . . . . . .6CG8A (mixer and Oscillator)

Sound IF and AFC—

V201 . . . . . .Oscillator for AFC detector/mixer (6BR8)
V202 . . . . . .½ AFC buffer amp and ½ mixer (6BR8)
V203 . . . . . .1st sound IF (6AU6)
V204 . . . . . .2nd sound IF (6CB6)
V205 . . . . . .3rd sound IF (6CB6)

Video IF and AGC—

V301 . . . . . .1st video IF (6CB6)
V302 . . . . . .2nd video IF (6CB6)
V303 . . . . . .3rd video IF (6CB6)
V304 . . . . . .4th video IF (6DC6)
V305 . . . . . .Amplifier and linear detector (6AM8A)
V306 . . . . . .DC amp and limiter (6AU6)
V307 . . . . . .DC amp and AGC control (12AT7)

Standby Carrier Module

V401 . . . . . .Oscillator and switch control (6DJ8)

CCV Converter Module—

V501 . . . . . .Oscillator (5654*)
V502 . . . . . .Doubler/Buffer (5654*)
V503 . . . . . .Mixer (6CY5)
V504 . . . . . .Output Amp (12BY7)

Power Supply

V101 . . . . . .Voltage regulator (0A2)

CCV-6 Series 2 Converter—(**)

V501 . . . . . .Mixer (6CY5)
V502 . . . . . .Buffer Amp (5654*)
V503 . . . . . .Output Amp (12BY7)
V504 . . . . . .Oscillator (5654*)
V505 . . . . . .Doubler/Buffer (5654*)

(*—5654 is ruggedized 6AK5)

How Sound AFC Functions

The sound IF and AFC module receives the sound IF carrier from the video IF AGC module through J203 IF IN terminals and is applied to the grid of the first sound IF amplifier (V203 — 6AU6) and AFC buffer amp V202B — 6BR8.

The output of V203 (6AU6) is coupled to V204 (6CB6), the 2nd sound IF amp. The output of V204 is coupled to V205 (6CB6), the 3rd sound IF amplifier.

Meanwhile back in V202B, the plate circuit of this buffer amp is peaked on 41.25 MHz. The output of the plate circuit is applied to the grid of mixer V202A (the same 6BR8), along with the 36.777 MHz crystal oscillator output of V201A (6BR8).

The plate of V202A is tuned to 4.473 MHz, the difference frequency between the 41.25 MHz sound IF and the 37.777 MHz oscillator.

The 4.473 MHz is then passed through the IF AFC limiter, V201B (6BR8). This sound output is brought to a pair of terminals, J201 AUDIO OUTPUT and J202 AFC OUTPUT.

J202 is connected to a filtering network in the power supply chassis which removes any audio from the AFC correcting voltage. AFC BALANCE meter M1 monitors the correcting voltage which is applied through AFC ON switch S103 to the varactor diode in the tuner.

The 4.473 MHz AFC intermediate carrier is chosen to avoid any audible beat with the 4.5 MHz appearing at the output of V202A. The 27 kHz beat produced is present, but outside of the audible range.

Normally the 36.777 MHz oscillator presents no special problems to the user. However, 2x 36.777 is 73.554 MHz, which falls in the channel 4-5 guard band.

CATJ Aligns Commander I

In the course of preparing this report for CATJ, a Commander I "borrowed" from a Midwestern system was brought into the shop and aligned, just as this report outlines.

The borrowed unit was one that saw regular service, and the system believed it was in proper alignment.

These photos show how we received it, and through the sequence, what we did to it

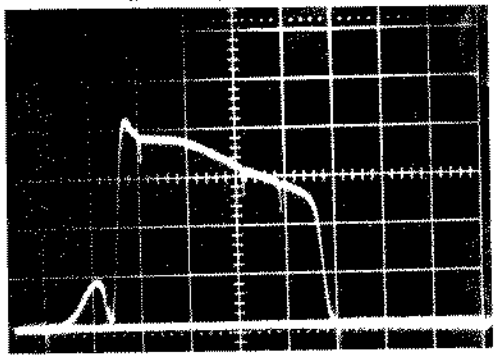


PHOTO ONE

to bring it up to factory specs.

The photo above is of the total unit **before alignment.** The aural (and color) end are tilted up approximately 5 db from the visual carrier side of the passband.

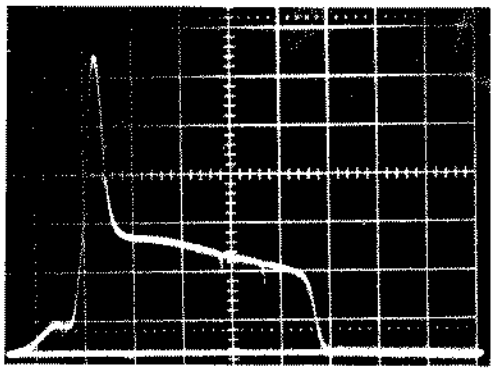


PHOTO TWO

Photo 2 shows the same **before alignment** with the aural carrier level control cranked wide open. Note that the aural carrier frequency, which is supposed to be controlled by the aural level control, is actually peaking the gain response down **between** the aural carrier and color subcarrier frequency.

To get proper aural output from this unit for system use, the operator was in effect peaking the color, resulting in much to vivid color on this channel.

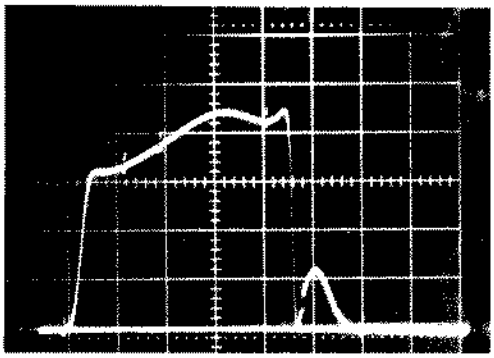


PHOTO THREE

In Photo 3 we see the video IF section before alignment. The 41.25 MHz sound trap is off-frequency and this was allowing aural carrier to get through the video IF and degrade the picture and cause the AGC some problems.

In Photo 4 we see the properly aligned visual IF.

In Photo 5 we see the aural IF before

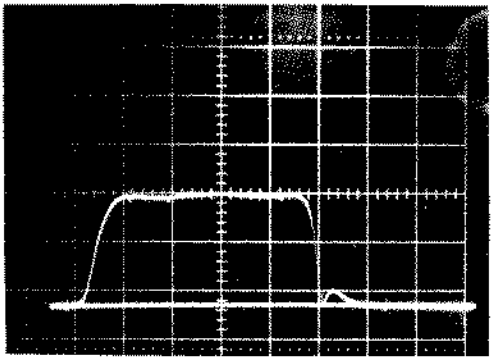


PHOTO FOUR

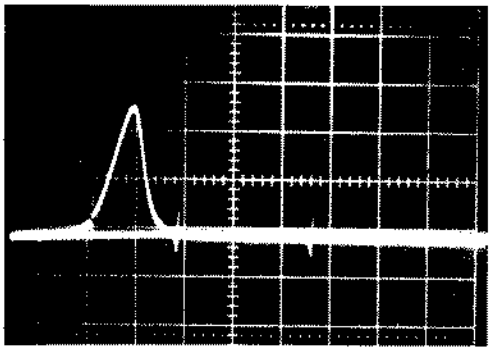


PHOTO FIVE

alignment. Note that it was peaked **between** 41.25 MHz (where it should be peaked) and 42.17 MHz. Thus through the aural portion the aural level was down resulting in a lower aural IF output level for the composite signal present. The resulting lower aural IF gain caused the operator to crank up higher on the aural level control to get his aural plant level up, which in turn resulted in over-rich color appearance that shows in the total unit peaking in Photo 2.

In Photo 6 we see the corrected aural IF response, centered on 41.25 MHz.

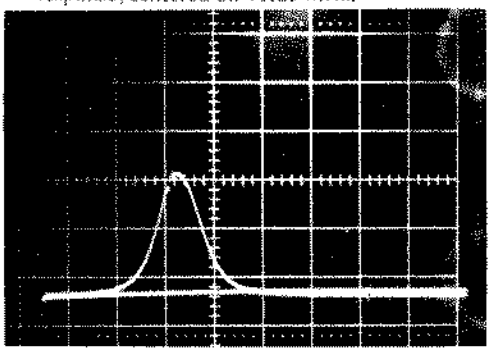


PHOTO SIX

In Photo 7 we see the AFC audio output response curve (see Figure 5 in text).

In Photo 8 we see the CCV (output converter/amplifier) before alignment; while not as "far out of spec" as the sound and video IF's, its response curve was "shifted" away from the desired passband, and out-of-flat.

In Photo 9 we see the same CCV module after alignment.

Finally, in Photo 10, we have a full sweep from input port to output port. To appreciate fully how much effort is involved, you should check on a unit or two of your own now in service!

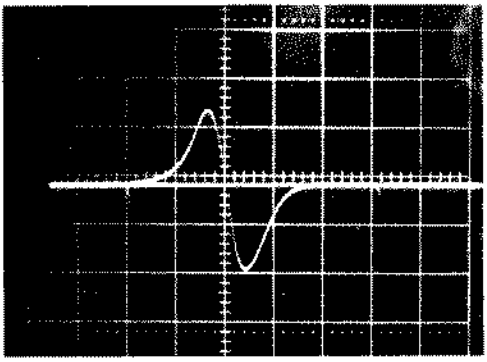


PHOTO SEVEN

NOTICE — CATJ LOOKING

CATJ growth to date necessitates that staff additions be made this summer. Foremost among these will be the position of advertising sales manager. CATJ will be looking for a person with well rounded CATV experience, who knows the industry and its suppliers well. Knowledge of magazine production would be helpful. Interested parties should contact Celeste Rule, Mg. Ed.

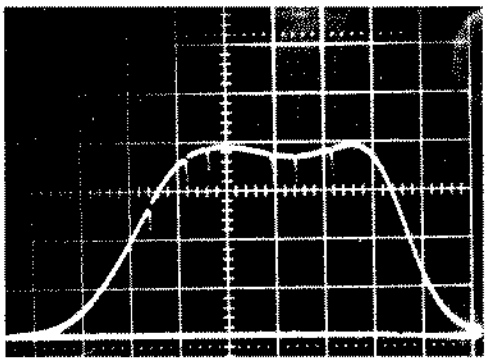


PHOTO EIGHT

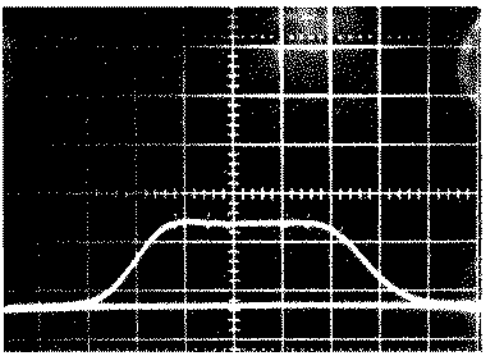


PHOTO NINE

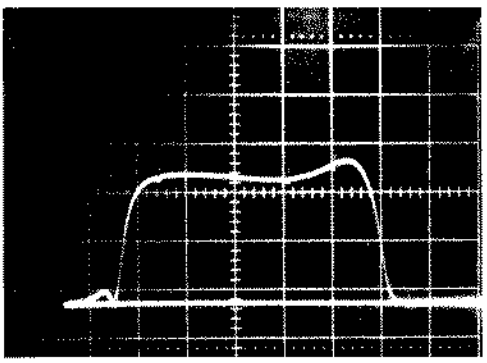


PHOTO TEN

TRUE MEANING OF SIGNAL TO NOISE RATIOS

Other than undesireable interference originating in man made or galatic sources, *equipment generated noise* is the most common picture and audio degrading factor in CATV system signal carriage.

For all practical purposes, equipment noise begins to become a major factor with signals below -20 dbmv or 100 microvolts.

A theoretical CATV amplifier, which contributes no noise of its own to the signal to noise ratio, has a noise threshold of -57 dbmv, or 1.4 uV. That is, if you were to terminate a *perfect* CATV (pre) amplifier (one that had a lowest possible noise contributing factor) with a 75 ohm terminating resistor, the noise generated by the passive resistor itself would be the equivilent of -57 dbmv.

Following the same *theoretical* limitations, to achieve a 40 db ratio between the (desired) signal and the undesired noise, the signal *into* the perfect CATV (pre) amplifier device would have to be in the -17 dbmv region (57 less 40 equals 17).

Fortunately for our considerations, we are able to achieve pictures that at least have the *appearance* of being 40 db *out of the noise* with levels appreciably lower than -17 dbmv.

Unfortunately for our considerations, the noise contributed by the equipment we utilize to amplify our signals is not as a rule the only noise we must contend with. Noise from man made (and even galatic) sources is usually the limiting factor to making commercial CATV use of signals that are quite weak. Or, co-channel gets us before the noise does so we are never really able to dig down into the noise limits of our systems.

FCC rules governing CATV systems specify that we must have signal to noise ratios of *not less than 36 db* on all signals delivered to our customers, when those signals are picked up first within the Grade A or B contours of the telecasting station (76.605(9)).

A photo chart prepared as a part of this report shows what carefully controlled laboratory signals "look like" for various signal to noise ratios, including 35 db signal to noise.

Seemingly, whether you are located within the Grade A or B contours, or beyond, having a 36 db signal to noise ratio (which the FCC considers adequate) would be a good goal to shoot for.

How you get it, and how you measure it with some degree of accuracy is our subject here.

What Is Noise?

Noise (contributed by the receiving system itself) is the result of random molecular motion in the antenna and the receiving system early amplifier stage(s). This random motion of the molecules is termed *thermal agitation noise,* and very small voltages are created by this molecular motion. Thermal agitation is totally independent of frequency. It is dependent upon the *resistance component* of the *impendance* which the input of the receiver sees, and of particular concern to television reception, the *bandwidth* of the receiving system.

The equation which results in a -57 dbmv "floor" for TV signal reception noise thresholds is based upon the facts just recited, with 75 ohms and 6.0 MHz receiving system bandwidths key factors in the equation. Thus even a noiseless TV front end would have a -57 dbmv *noise floor.*

However, to this we must add the random

irregularities of the current flow in the amplifier devices themselves. This current-flow noise is termed *shot-effect noise* and it has an equivilency as follows:

> In any given device it is the resistance required to be placed in the input circuit to develop a noise voltage which will be the equivilent noise in the output circuit of the device alone.

This is expressed as *equivilent noise resistance* and it assumes for measurement purposes that the device is being referenced against a theoretical device with a noise figure of zero.

Thus an ideal receiving system would generate no noise on its own, and the only noise contributed would come from the antenna system random molecular motion and the atmosphere itself.

CATV equipment noise figures are a measurement of the equivilent noise voltages of the receiving equipment (i.e. pre-amplifier, signal processor, line amplifier, etc.). Because noise is an enemy of good quality pictures, and good looking pictures only "happen" when we have reasonably high ratios of signal and noise (so-called signal-to-noise ratios), a high receiving equipment noise figure works to our disadvantage. The higher the receiving unit noise figure, the greater our TV input signal voltage must be to produce good clean noise free pictures.

For CATV purposes, on a practical level, we can do some projections of receiver noise figure as shown in Table 1. Recall that decibels are an expression of power ratios. Noise voltage is really not an accurate term because of the random frequency response of the noise. Voltage suggests a specific measurement point, whereas noise voltage within a 6 MHz wide bandwidth is really a summation of *all* of the noise in that bandwidth.

One of the primary factors which determines noise figure (or equivilent signal to noise ratios) is the bandwidth of the receiver. Forgetting for the moment that we need at least a 4.5 MHz wide bandwidth to handle the wide modulation index of the TV video information, an improved signal to noise ratio is guaranteed if you can (or could) halve the receiving bandwidth. Unfortunately we cannot play around with bandwidth, at least below 4.5 MHz, in TV

TABLE ONE

This table sets forth the noise figure equivilents and signal level equivilents for common CATV equipment.

dbmv Level	*Noise Figure*	*Microvolt Level*
-57	0 db	1.4 uV
-56	1 db	1.6 uV
-55	2 db	1.8 uV
-54	3 db	2.0 uV
-53	4 db	2.2 uV
-52	5 db	2.5 uV
-51	6 db	2.8 uV
-50	7 db	3.2 uV
-49	8 db	3.6 uV
-48	9 db	4.0 uV
-47	10 db	4.5 uV
-46	11 db	5.0 uV
-45	12 db	5.6 uV
-44	13 db	6.3 uV
-43	14 db	7.0 uV
-42	15 db	8.0 uV
-41	16 db	9.0 uV
-40	17 db	10.0 uV

TABLE TWO

This table sets forth the *theoretical signal to noise ratios* experienced with a -20 dbmv (100 uV) input and various front end noise figures.

Noise Figure	*Signal to Noise Ratio*
17 db	20 db
16 db	21 db
15 db	22 db
14 db	23 db
13 db	24 db
12 db	25 db
11 db	26 db
10 db	27 db
9 db	28 db
8 db	29 db
7 db	30 db
6 db	31 db
5 db	32 db
4 db	33 db
3 db	34 db
2 db	35 db
1 db	36 db

receiving systems to improve signal to noise ratios, because we begin to chop out essential portions of the modulated signal and there upon lose picture definition.

Thus bandwidth is not one of the things offering big potential for system signal to noise improvement in typical CATV equipment. However, it is worth pointing out that wide band amplifiers (i.e. *all channel* preamplifiers for example) have a much larger noise-factor than single channel versions.

There is not much that system operators can do about the equipment noise (factor); it is what it has been designed to be and you must make the best of what you have.

However, an understanding of how noise figure and system gain relate is helpful. Assume we have a -20 dbmv input signal to our first pre-amplifier. This is the average antenna level signal for our example system.

Based upon Table 2, the best we can get with a 17 db noise figure front end is a 20 db signal to noise ratio. A 17 db front end would represent a UHF front end (u to V converter) with no RF amplifier.

Or, with an 11 db noise figure front end, the best we can hope for is a 26 db signal to noise ratio. An 11 db front end would represent several of the VHF signal processing units available today.

With a 5 db front end, the best we could hope for would be a 32 db signal to noise ratio. A 5 db front end would be a middle grade signal pre-amplifier.

With a 2.0 db front end, the best we could hope for is a 35 db signal to noise ratio (*almost* spec for 76.605 (9)). A 2 db noise figure would represent a good grade VHF pre-amplifier.

In each case the input level remained the same (-20 dbmv or 100 uV); the only thing we changed was the noise (factor) contribution of the front end.

The front end is of course the first amplifier stage which the antenna delivered signal goes through.

A -20 dbmv signal level is too low for a processor directly. Most signal processing units must have at least -10 dbmv for the AGC system to function and even this is the bottom of the AGC range for such units. To be safe with almost any processor unit, and to allow for downward signal fades, the processor wants to have around +10 dbmv *on the average.*

To reach +10 dbmv from an average antenna level of -20 dbmv requires 30 db of gain — *plus* — whatever the db loss in the db loss in the downline.

A signal processor with an 11 db noise figure will still be showing *slight* grain in the picture with inputs as high as -11 dbmv (280 uV). This is a 35 db signal to noise ratio for an 11 db noise figure unit.

A -11 dbmv antenna level signal is pretty potent, but not high enough for most processor AGC's to function. Therefore, the normal approach is to add a pre-amplifier.

Since we only want to average +10 dbmv, seemingly the pre-amp gain we require is on the order of 21 db (the difference between -11 and +10). And with an average middle range VHF pre-amp 5.0 db noise figure, this sounds like it might be the minimum spec for the pre-amp we are after. That is, 21 db of gain and around 5.0 db noise figure.

But is it?

An 11 db noise figure with a -11 dbmv input signal was a 35 signal to noise ratio. Now a pre-amplifier is added ahead of the 11 db noise figure processor. It has a 5 db noise figure which means that the signal to noise ratio will be 11 minus 5 or 6 db improved over the processor. That would be a 41 db signal to noise ratio. With such a pre-amp installed our system signal to noise ratio for the channel becomes 41 db at the input to the processor, while the processor now has an input voltage close to the +10 dbmv requirement.

The antenna level in our example has been tagged at -11 dbmv. This would be the average antenna level; on good days the signal is up some, and on bad days it is down some from that value. For each db above -11 dbmv, the signal to noise ratio improves by a corresponding db. And for each db below -11 that the signal drops, the signal to noise goes down accordingly.

For example, if the signal fades down at the antenna to -20 dbmv, the following happens:

(1) The input to the pre-amp becomes -20 dbmv.

(2) With a 5 db noise figure pre-amp this results in a signal to noise ratio of 32 db. This is definitely a grainy (noisey) picture.

(3) The input to the processor has dropped from +10 dbmv (approximately) to +1 dbmv (approximately).

Checking the input to the processor, noting that the input level is around +1 dbmv,

many operators would assume they were well up into the noise free region. *The grainy appearance to the picture would be a bit puzzling.*

It is not just signal voltage that determines signal to noise ratio however. In fact, signal voltage is secondary to noise voltage, *and the ratio between signal voltage and noise voltage.* And this ratio becomes cast in concrete for the entire CATV system at the input/output of the first amplifier unit on the channel in the system. With a fade down to -20 dbmv in our example, this ratio will never be any better than the 32 db that is established at the output of the pre-amp. No amount of gain, nor having a lower amplifier noise figure later on in the system, will ever improve on this 32 db best case ratio.

Measuring Noise Figure

Most operators assume noise figure measurements are conducted in back rooms by super engineers with thousands of dollars in exotic measurement equipment. This can be so, but it is not necessary to have quite that amount of equipment or experience to do a creditable job.

Noise figure measurements are routinely made on signal pre-amplifiers by many manufacturers, but seldom on signal processors or line amplifying equipment.

All you really need is a reliable noise source, a calibrated pad, a FSM and some knowledge of what it is you are doing.

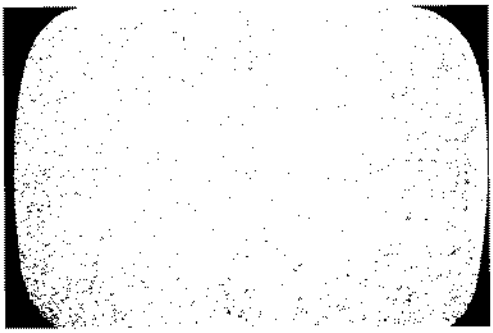
Reference is made to Diagram 1. The amplifier to be tested is terminated with its input impedance (75 ohms). The amplifier is powered and the FSM is tuned to the frequency of interest. In the case of a single channel amplifier, this is the visual carrier frequency.

DIAGRAM ONE

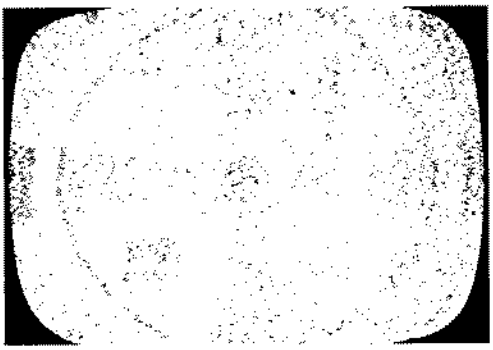
Attenuation is removed from the internal pads of the FSM until you have some *convenient* scale reading. What you are seeing is the total output noise of the amplifier and its input termination.

Refer now to Diagram 2. The 3 db precision pad cuts the output noise by 3 db. The termination is replaced by a *metered noise source* (the Anaconda 9952 Noise Generator) and the pot control on the 9952 is advanced until the FSM reads the same noise level scale as you previously had with the termination in place.

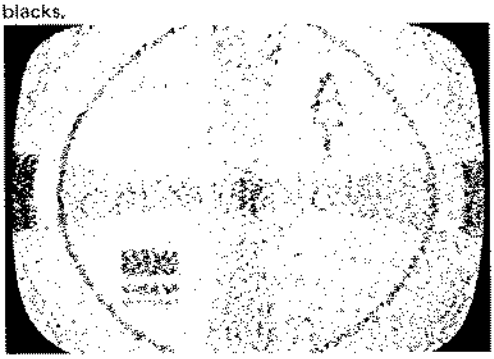
The FSM is used merely as a calibrated volt meter, reading out not noise figure db's



0 db signal to noise ratio (equivilent parts of noise and signal) produces the hint of a "frame bar."



5 db signal to noise produces heavy contrast blacks.



10 db signal to noise produces slightly improved contrasts but still no detail.

but reference voltage scales. For example, if in the terminated mode you read 0 db of scale (voltage) reading, in the test mode with the 9952 as a calibrated source replacing the 75 ohm terminator, you adjust the 9952 output level pot for the same "0 db scale reading".

When the 9952 has been adjusted to produce the same noise output as the termination, you read the noise figure of the amplifier from the meter scale on the front of the 9952. It meters calibrated plate current of the noise generating diode in the 9952, and is scaled in two ranges of 0-8 db noise and 8-16 db of noise.

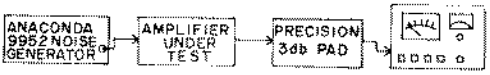
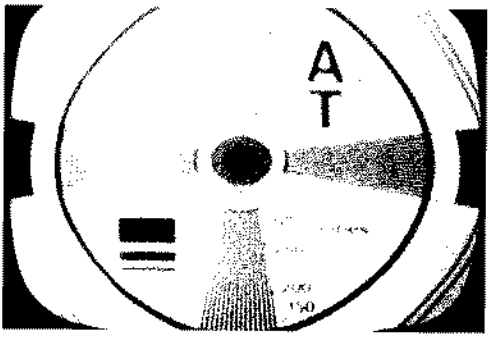
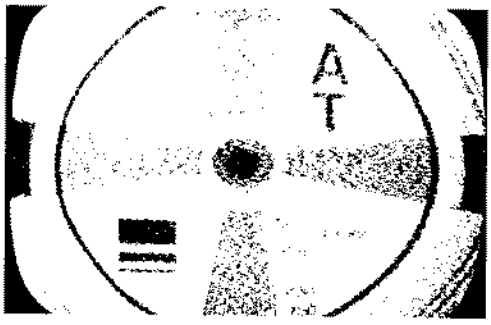


DIAGRAM TWO

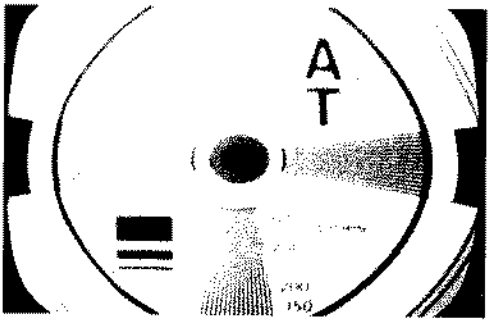
15 db signal to noise produces the start of some detail.



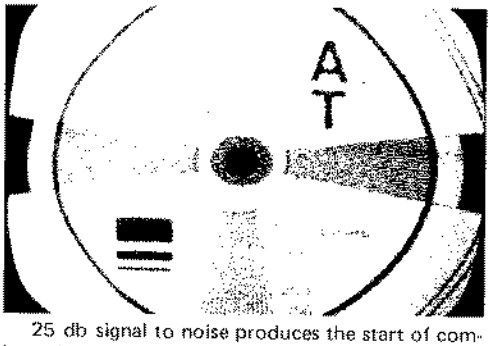
30 db signal to noise starts to show a marginal level of comfortable viewing.



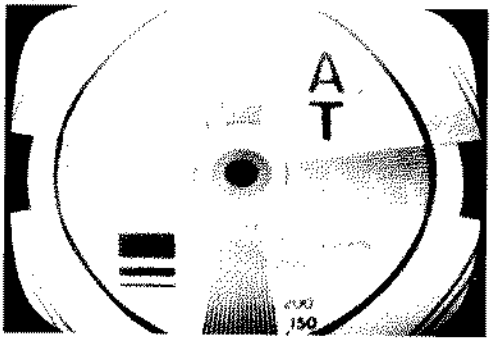
20 db signal to noise provides enough detail for large characters.



35 db signal to noise still shows modest grainy appearance.



25 db signal to noise produces the start of comfortable viewing detail but still a basically noisey picture.



40 db signal to noise removes the last signs of noise from the screen.

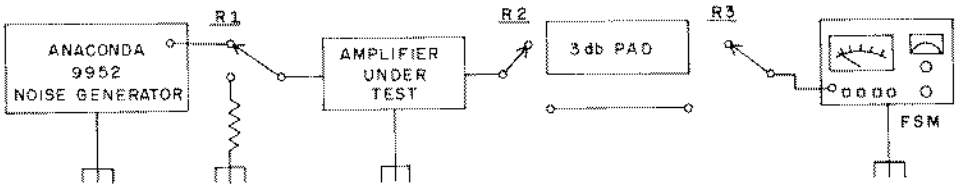


DIAGRAM THREE

Diagram 3 shows how you might set up a permanent test station utilizing three 75 "F" fitting relays (Dow-Key DK77G are suitable relays) wired in parallel so that one switch takes you from a terminated mode to a noise measuring mode.

The only piece of equipment you really need, that you probably do not have, is the Anaconda Electronics Ltd. (made in Canada by that branch of Anaconda but available in USA) 9952 (*). It is not a very expensive unit to have around, and if you maintain any quanity of head end equipment, it is almost a must.

(Anyone who repairs their own lightning damaged pre-amplifiers should be advised that minute adjustments in the pre-amp after a FET or bi-polar transistor is changed for a new one are absolutely necessary if you are going to get back the manufacturer's noise figure spec. Neutralized bi-polar devices are especially critical for noise figure optimizing, something you can only do with a noise figure test facility such as described here. And as an aside, optimum (i.e. lowest) noise figure and maximum gain are seldom found at the same tuning spot on any tuned amplifier stage.)

Comparing Noise Figures

If you cannot measure noise figure, you can usually compare noise figures for similar units. This will *not* give you an *absolute noise figure measurement* (even if you know accurately the noise figure of one unit), but it *will compare the relative noise* figure of two units.

See Diagram 4. A unit with a known gain of 25 db is terminated, turned on, and the FSM is used to measure as accurately as possible the noise level reading on the desired frequency.

*—*Anaconda, Ltd., 305 N. Muller, Anaheim, California 92801 (U.S. office)*

See Diagram 5. A second unit of known gain of 30 db is terminated. The *difference* in gain between unit "A" and "B" (5 db) is inserted as a pad in the output line of the second amp so we are comparing two units of the same voltage gain.

The FSM is read directly for the reading difference between "A" and "B". If one unit gives a higher noise output than the other, relatively speaking (the gains of the two have been equalized) the lower reading noise output indicates a lower noise figure unit.

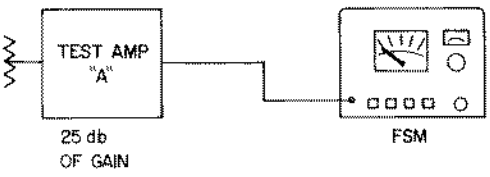


DIAGRAM FOUR

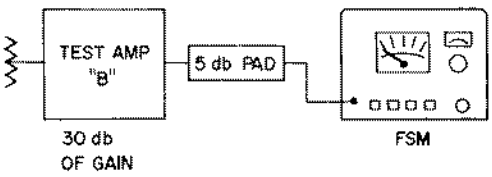


DIAGRAM FIVE

Note: Do not try to read the direct db difference indicated by the FSM as an *absolute number* of db's difference in noise figure of the two. And if you are measuring a single channel (pre) amplifier, rock the FSM tuning dial through the entire channel, noting the highest reading found within the desired channel range. Some units have peak noise outputs at points *other than* the visual carrier frequency.

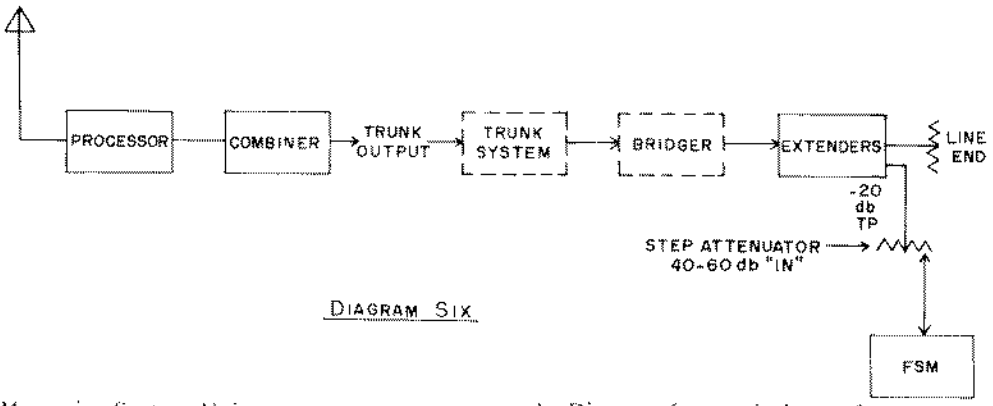


DIAGRAM SIX

Measuring System Noise

Adequate accuracy system signal to noise ratio measurements can be made to satisfy the requirements of 76.605 (a) (9) and 76.609 (e) by following the following procedure.

The rules require three measurement points within the system, one of which must be at or after the most distant (by cable and amplifiers) cable point in the system.

Signal to noise ratios are required only on those signals which are first received with-in their Grade "B" contours. This basically means any off-the-air signals you pick up at your head end, for which your head end is within the Grade B contour, or, any microwave delivered channel where the microwave pick-up point is located within the Grade B contour, must be measured for signal to noise ratio.

There are many sophisticated methods of measuring signal to noise on a plant. The FCC will, however, accept a pretty simple approach to this measurement.

In Diagram 6, a typical set of parameters are shown. The cable system channel input, at the signal processing unit, feeds through the combining network, down the trunk through trunk amplifiers, eventually through a bridge amplifier and then *through one or more* line extenders. For this example, we establish our measurement point at the *output* of the *last line extender* on this leg (this could well be the "deepest" extender in the plant).

We assume the line extender has a 20 db back matched output test point; this gives us a relatively high level RF voltage reading for the visual carrier of the channel in question.

Between the output test point and the input to the FSM, we install a 1 db step attenuator (a range of 0-61 db is more than adequate). *All* attenuation is taken out of the FSM (i.e. it is operated in a wide open, or most sensitive mode) and attenuation is cranked into the 1 db step attenuator until we have a convenient reference scale reading on the FSM. (Assume it reads 0 on the scale, or mid-scale).

Refer now to Diagram 7. The input to the signal processing unit is replaced with a 75

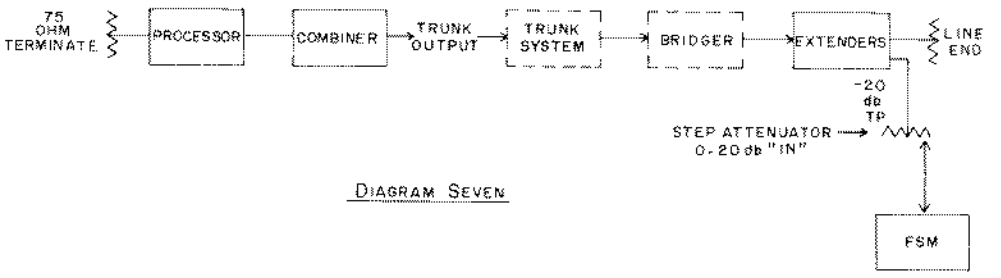


DIAGRAM SEVEN

ohm terminator, to establish a loaded (matched) input condition, with a -57 dbmv noise level. Now the noise generated by the processor is the noise figure of the processor.

Back on the line extender in Diagram 6, we leave the FSM peaked (as in previous step) on the visual carrier (and do not touch the dial); start cranking attenuation *out* of the external 1 db step attenuator until the FSM needle moves back up to the same (mid-scale) reference point where Diagram 6 adjustments were made.

The db difference between the amount of attenuation *cranked in* for Diagram 6 measurements and taken *out* for Diagram 7 is the rough signal to noise ration difference between your signal (Diagram 6) and your noise (Diagram 7).

Example: you had 50 db of step attenuator cranked in to get your *reference scale reading* in Diagram 6. In Diagram 7, you had to take out 40 db (leaving 10 db) from the step attenuator to get back to the same reference scale reading point. The rough signal to noise ratio is 50-10 (40 db); a signal to noise ratio of 40 db.

Actually the true signal to noise ratio, in this type of comparative test is from 2 to 3 db *worse* than the 40 db we measured, because the typical FSM sees only 500-700 kHz of the 4.5 MHz wide TV (information) bandwidth. When we add in a correction number for expanding the bandwidth to the full TV channel, we lose a couple of db of signal to noise ratio. You can be safe if you *take 3.0 db from* what you measure, regardless of the FSM you are using.

While this test is required (76.605 (a) (9)) only on Grade "B" (or better) contour signals, it pays to run the tests on all channels to assure yourself that you have future references for checking long term system signal quality.

Note: The Commission has never dealt directly with the question of *where* your system signal to noise ratio is truly established.

If you operate a processor with *no* preamplifier, the system signal to noise is established at the processor.

On the other hand, if you have one (or more series) pre-amps ahead of the processor, the system signal to noise is really established in the pre-amp and not the processor.

Thus you should *really* be terminating at the *input* to the pre-amp and not the input to the processor.

If your processor has a typical noise figure of 11 db, and your pre-amp has a 2.0 db noise figure, your system signal to noise ratio measurements will be (in this example) 9 db *better* than you measure by terminating the processor.

76.605 (a) (9) requires that you maintain a 36 db signal to noise ratio on Grade "B" contour (or better) signals. If you start coming up short of this minimum requirement with a terminated processor source, and you have a pre-amp ahead of the processor with a better noise figure, you should be terminating the pre-amp instead. Otherwise you will be short changing yourself the difference in noise figure improvement provided by the pre-amplifier.

SIGNAL TO NOISE CHART Pgs. 32-33

In the CATJ test facility a locally generated RF source (modulator) provided a reference signal.

A CATV demodulator operating on a high band channel provided video output.

The demodulator output was photographed for precise signal to noise ratio levels measured with a freshly calibrated FSM and spectrum analyzer.

SLE-20

SINGLE ENDED EXTENDER

(In the May issue our theory feature looked into basic single ended line extender design parameters. Following up on the basics of single ended design, CATJ this month looks at the Jerrold SLE-20 (Starline) Extension Amplifier. This includes SLE-20A, SLE-20A-VI, SLE-20B and SLE-20B-VI models.)

Reference is made to the schematic diagram on the opposite page.

The RF input signal plus the AC line powering voltage passes into the unit through J-101. C1 and L2 form a high (frequency) pass circuit.

J2 is the input side of a plug-in pad (for level adjustment). The RF signals after padding pass through an equalizer network, made up of L4, C3, R3 and C4 (which pass high band signals), and, L3, C5, R2 and L5 which shunt low band energy to ground (thereby equalizing the input in favor of the high band signals). Note R1 and R4 are 75 ohm resistors which establish the match for the equalizer.

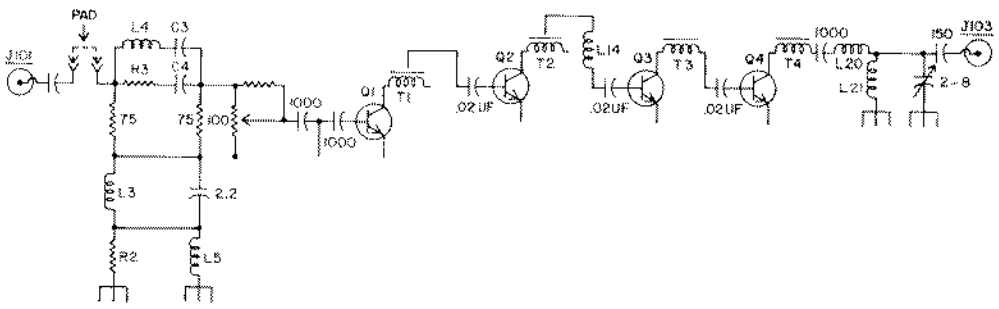
Out of the equalizer network, the signal is coupled into R5 which is the gain control circuit. R6 limits the range of R5 and, with R7, the pair maintains proper impendance match of the control.

Then the signal is coupled through C6 and C7 to the base of Q1, the first amplifier stage.

Q1's operating point is set by R10, R8, and R9. The collector current is set by R11 and R12. Notice the *voltage feedback loop* (see CATJ for May) established by C9, R8, and L8. Also notice the *degeneration of the emitter* through R11.

The signal is then coupled out of the collector through an impedance (step-down) transformer (T1) to C13 and into the base of Q2.

The second stage of amplification, Q2, operates virtually the same as Q1 with the



addition of the tilt control (R17) which adjusts the *amount of feedback* from the collector to the base. This in turn compensates the stage gain by lowering the low band gain of the stage. In stage Q2, L12, L13 and resistor R16 determine the response curve of the stage. R13 limits the range while the capacitor C13 couples feedback into the base.

The signal path out of Q2 is through transformer T2, L14, and C17 to the base of Q3.

Q3 is strictly an amplifier. Notice, however, that the emitter resistor, R24, is much smaller (51 ohms) than Q1 or Q2 emitter resistors (R12 and R19 are 270 ohms each); this causes a higher collector current which in turn improves the cross-mod characteristics of the stage. As the next-to-last stage in the amplifier, output-type levels are building up quite rapidly now.

Out of Q3, the signal is fed through T3 and C21 to the base of Q4. Here again we have a straight forward amplifier with the emitter resistor again low in value (51 ohms) to maintain a higher collector current for improved cross-mod characteristics.

Out of Q4 the signal passes through impedance matching network C24, L20, L21, C27 and C26 to output jack J103.

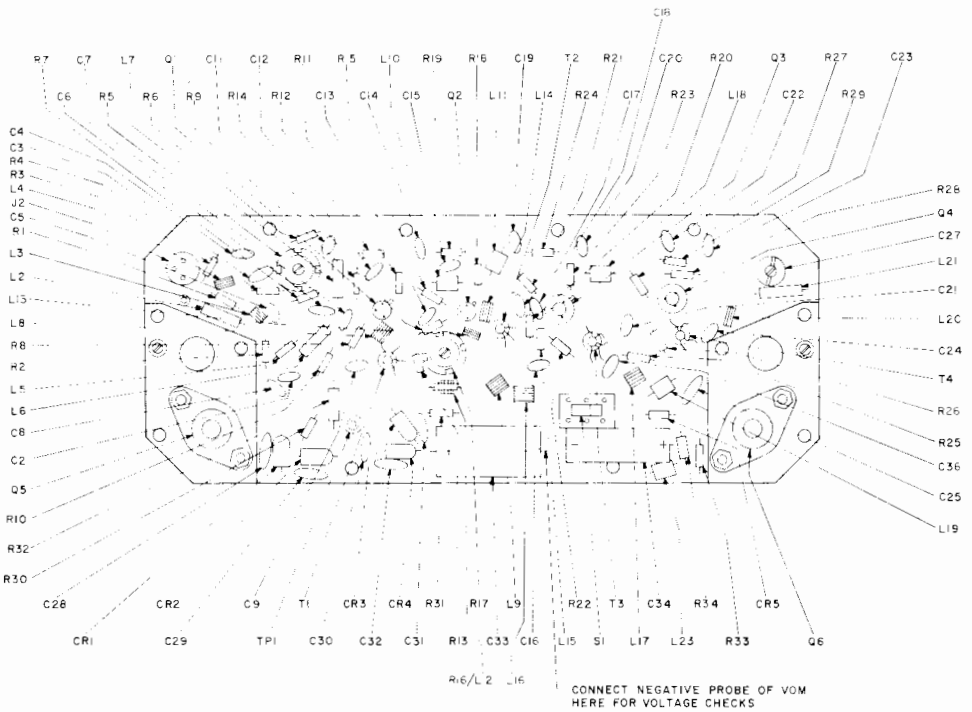
Powering

L1, L22, C30 and C35 provide a low pass filter to pass AC line voltage *around the amplifier* and into the internal supply for amplifier.

In the power supply, CR1 and CR2 create positive operating voltage while CR3 and CR4 provide the required negative operating voltage. Stray RF is bypassed with capacitors C28, 29, 31, and 32 around the power supply rectifier diodes to insure that no RF is detected by the diodes.

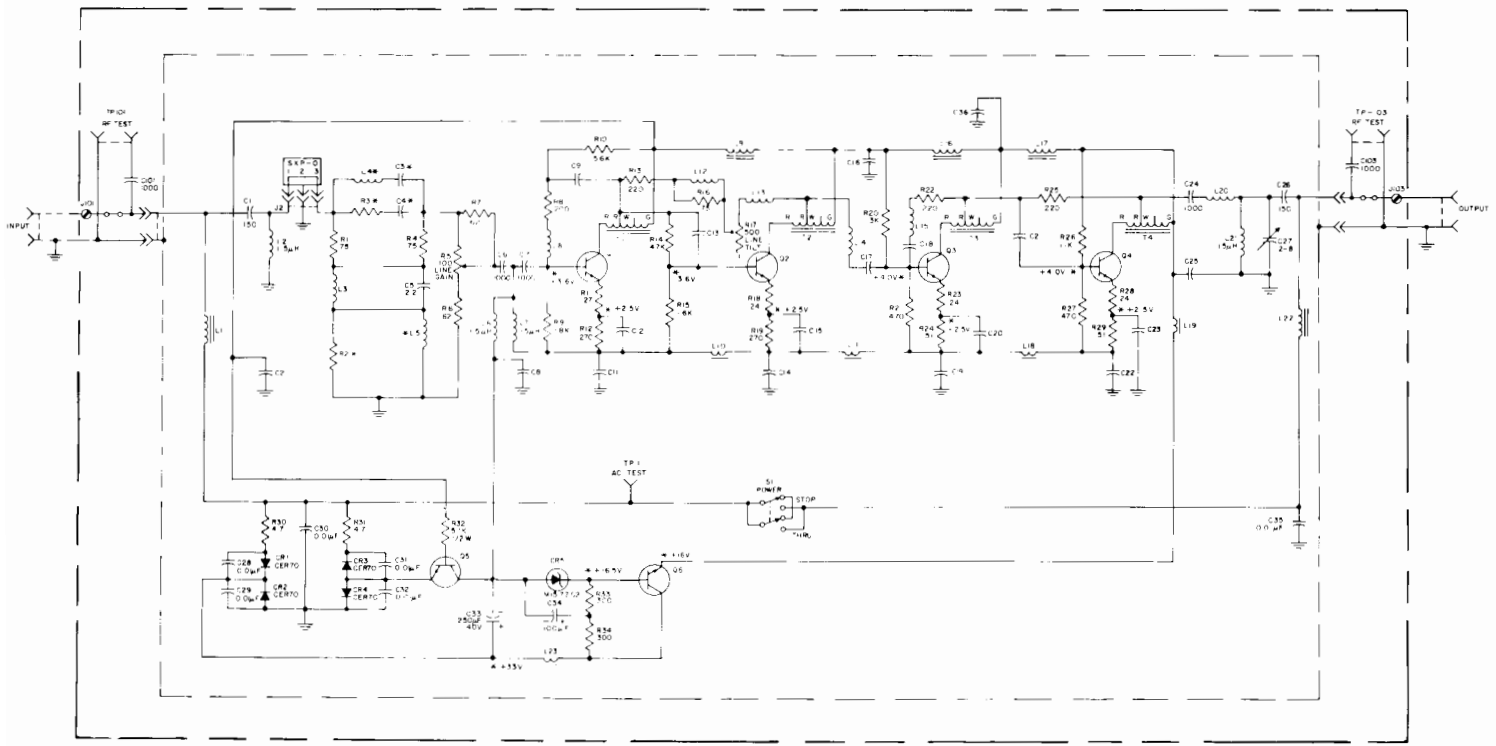
The heavy power supply filtering is done by 250 uF C33.

NOTE: When making any voltage checks



Printed Circuit Board Component Layout

MODELS SLE-20A & SLE-20A-VI
& SLE-20B & SLE-20B-VI



COMPONENT REFERENCE TABLE						
MODEL	C3	C4	R2	R3	L4	L5
SLE-20A, -20A-VI	56pF	20pF	39Ω	270Ω	3 1/2 TURNS	2 TURNS
SLE-20B, -20B-VI	27pF	56pF	300Ω	75Ω	5 TURN	5 TURNS

VIEW FROM WIRING SIDE

NOTES
1. UNLESS OTHERWISE SPECIFIED:
2. ALL UNMARKED CAPACITORS ARE COPM
3. ALL OTHER CAPACITORS IN pF
4. ALL RESISTORS IN OHMS 5%, 1/4W
5. ALL DC VOLTAGES MARKED ✱ MEASURED FROM COLLECTOR OF Q5 AT 30V RMS INPUT.
6. AC TEST POINT MEASURED TO GROUND.
7. ✱ = SEE TABLE FOR COMPONENT VALUE

the negative lead of the VTVM must be connected to the negative side of this capacitor and *not* to case ground.

Zener diode CR5 provides a reference voltage while Q6 is a series regulator. Transistor Q5 is a protection device that will protect the rest of the circuit should one of the other parts fail. Basically, it functions as a fuse (or circuit breaker, depending upon the type of short).

Inductors L16, 17, and 9, and, capacitors C2, 16, and 36 provide isolation on the B-plus line to prevent unwanted inter-stage feedback and/or oscillation.

L11, 10, and 18, and C11, 14, 19, and 22 provide the same protection for the negative supply side of the line.

In addition to the full SLE-20 schematic shown here, CATJ has prepared a mini-schematic showing the path of the RF signal from the input to the output.

The RF probe, for use with a sweep input, described in the May CATJ should also be employed for stage by stage RF checking if the problem seems to be tilt or gain oriented.

Trouble shooting the SLE-20 should begin with voltage measurements, utilizing a good quality FET, VOM, or VTVM. If the measured vary more than 10% from the voltages given in the full schematic, the area with improper voltages should be closely inspected for component changes. If resistors seem within their tolerance ranges, but one stage shows consistently off-measurements, the transistor should be changed out.

Finally, note that some components have different values between the SLE-20A and SLE-20B series of units. These changes are shown in the full page schematic of the amplifier in the *component reference table* box.

CABLE BUREAU COMMUNIQUE

An extraordinary document released by the Federal Communications Commission April 22 (*) deals with **clarification of rules and notice of proposed rule-making.** The document is unusual for several reasons, including the fact that it deals with seven separate proposed rule makings for the CATV industry. Additionally, the document seeks to clarify a number of points which have come to the Commission's attention since the Cable Television Report and Order was adopted by the FCC on February 02, 1972: and subsequently became effective March 31, 1972.

In the more than two years since Part 76 Rules and Regulations were established, nearly 3,700 applications for federal Certificates of Compliance have been filed with the FCC. In those 3,700 applications, the Commission believes it has seen just about every attempted dodge and wrinkle that an ingenious CATV industry can throw up for discussion. On a case-by-case basis, policy has been formulated to deal with these "wrinkles": but in some cases the "wrinkles" were so unique that Cable Bureau attorneys have hard pressed to deal directly with the proposals. Thus the simultaneous clean-sweep approach to adopting some new rule-making procedures; seven in all, at one time.

In releasing this simultaneous clarification of existing rules, and notice of proposed rule making(s), the Commission is attempting to codify the rules in those areas where a simple announcement of policy change will suffice, and, throw out for industry comment those (seven) areas where additional input is required.

Each of the seven proposed rule-making documents is a separate rule making proceeding unto itself. **Any member of the public interested in the outcome of these proposals is invited to comment on the specific rule-making proposed (1) prior to the June 07, 1974 deadline for comments.**

Policy-Signal Carriage

The Commission has pre-empted jurisdiction of any and all signal carriage regulation. Applications to the Cable Bureau which include franchises (ordinance) that attempt to delineate the signals to be carried by the CATV system often slow down the certification process. When the franchise (ordinance) includes signal carriage (by station and channel number) which is inconsistent with the regulations, it requires special treatment and often requires that the applicant go back before the city council for a modification of the franchise (ordinance).

However, when there is a **joint petition by the cable operator and the franchising authority** for a **waiver of the leapfrogging rules** based upon a showing of community interest (between the CATV community and the transmitter community), the Commission will continue on an **ad hoc** basis to consider such requests, and to give added weight to the petition originating with the community itself.

Here the Commission is recognizing that local conditions are best identified by local people, and where a substantive showing can be made, leapfrogging waivers may be granted.

Policy — Signal Deletion

In 76.13 (a) (1) and (b) (2) the Commission requires a listing of stations a system is authorized to carry as well as specific requests for additional signal(s).

In many instances, "there are clearly more signals authorized than could be technically carried or desired."

The Commission intends to amend their rule so the applicant will indicate **the signal(s) to be deleted as well as to be added.**

The Commission recognizes that some signals are carried part-time and this descretion remains in the hands of the system operator (where mandatory full-time carriage is not required).

A procedural change in 76.55 (b) will therefore be made to reflect this change.

Policy — Access Channels

The Commission takes note that **communities** outside of the major markets are now beginning to require access requirements in franchise renewal hearings.

The Commission does not believe, in major markets, the four required access channels are "overly burdensome". However, for small communities operating in major markets, and especially single head end systems serving two or more distinctly separate political subdivisions, **"there is no need to have a separate public access channel for each community."**

Consequently, the Commission will continue to handle such situations by waiver request although it puts the industry on notice that **"we still expect and require operators to have sufficient channel capacity to meet any reasonable demand".**

In smaller communities, outside of the major markets where access channels are required, the Commission will allow the "addition of such (access channel) requirements provided the requirements are no greater than those in effect for major market communities".

SEVEN DOCKETS

What Is At Stake?

Briefly, the Commission is proposing to change CATV rules in seven (7) Key areas. They are:

Docket 20018: Federal preemption of CATV technical standards, or, a moratorium of non-federal standards.

Docket 20019: Additional rules to prescribe how franchise hearings should be conducted by franchisors.

Docket 20020: Clarification of rules relating to mandatory line extensions into unserved areas in your franchise region.

Docket 20021: Amendment to lengthen CATV franchise terms to 25 years under some circumstances, and impose a 5-7 year minimum term.

Docket 20022: To adopt specific rules to compensate a CATV system operator if he has his franchise cancelled or cannot obtain a renewal.

Docket 20023: To adopt rules pertaining to Commission involvement in transfer of CATV system ownership.

Docket 20024: Amendment of rules to name specific local government official responsible for handling CATV subscriber complaints.

*—Published in toto in the Federal Register for April 22, 1974.

Policy — Channel Capacity

The Commission has once again gone on record as "warning" communities that are contemplating **massive** extra bandwidth capacity ("such as operational capacity for 120 video channels") that **"the need or value of such excess has yet to be proven."**

Policy — Facility Requirements

The Commission is voicing concern about the "access program" and **"the burden it imposes on the cable operator".**

The Commission "envisions the access program as an opportunity for a multiplicity of persons and groups to become active in the use of the communications media for the first time".

However, the Commission points out "this is not accomplished by demanding that the cable operator, having provided the free channels, must also pay to program the channels".

The Commission noted **"demands are being made for excessive amounts of free equipment, free programming and free engineering personnel to man the equipment".**

Additionally, "cable subscribers are being asked to subsidize the local school systems, government and access groups. Too often these extra equipment and personnel demands become franchise bargaining chips rather than serious community access efforts."

And the public is warned **"We do not think more demands on the cable operator will make public access a success".**

"Access will only work when the rest of the community assumes its responsibility to use the opportunity it has been provided".

Here the Commission appears to be softening its line on access channel requirements; to the extent that it may now be recognizing the considerable financial burden providing access channels can impose on the cable operator. More is said about this further on.

Policy-Bandwidth Requirements

The Commission seeks to clarify **"when extra band width capacity must be activated".**

"No system will receive a Certificate of Compliance if its activated capacity is insufficient to meet access channel requirements (including at least one channel available for leased use). This is assuming that the remaining capacity can be activated without significant rebuilding or delay".

Accordingly, the Commission will clarify the language of 76.251 (a) (8) to state that when an access channel of any classification or category (i.e. public access) becomes 80% utilized for any consecutive three-hour period, for six consecutive weeks, the cable system will be obligated to activate another access channel of the same classification or category; regardless of the activity level of other access channels on the system of differing classifications or categories (i.e. educational access).

Policy — Two-Way

In 76.251 (a) (3) the Commission requires the technical capacity for non-voice return communication.

This rule does not, however, **require that a cable system be operational in the return mode.**

The Commission updates its thinking in this area by stating **"We are aware that at present there are few proven, economically viable uses for two-way cable communications."**

"To impose operational two-way systems at this time might impose unreasonable costs on the cable operator. In some cases we have noted that franchising authorities are requiring the immediate operational installation of two-way facilities."

"Before a Certificate of Compliance is granted in such a case, **we require a showing of the intended use of such facilities** and a showing that such a requirement will not adversely affect the system's viability."

Once again it **appears** the Commission is **coming to the rescue of the cable operator** who is faced with demands for immediate two-way operational system(s); by the franchising authority.

Policy — Free Channels

76.251 (a), (4) (5), and (6) require the provision of public, educational and governmental access channels.

The Commission notes that it is "reluctant to allow major alterations by individual franchising authorities without good cause".

The Commission is concerned with some local thinking that "more may be better"; to which the Commission answers "more may be worse".

Accordingly, **before a Certificate of Compliance with a franchise will be issued** for a system that has **demands for access channels** above the requirements of the Commission, "a showing in the application must indicate what the nature of the added requirements is, how it will be implemented, who will pay for the extra services and equipment, and how much they will cost, and how the costs, if borne by the cable operator, will add to rather than detract from his overall (service) offering."

The Commission is plainly against any franchise requirements which exceed those set down by Part 76, and will not act favorably or in haste with applications that include unreasonable requests or demands from the franchising authority.

Policy-Access Regulation

Proper uses and procedures for use of access channel (in particular public access) received some Commission comment.

"Our effort," the Commission writes, "at creating a public access channel was meant to give the maximum access possible to local groups".

"Should our rules allow a particular person or group to reserve access time on a long term basis: i.e. every Thursday night from 8-9 p.m?"

"We did not intend that our (rules) would prohibit an access programmer from developing a viewership at a particular time by consistent programming."

"This type of reserved time would be consistent with our rules. However, we also want to assure that all desirable time slots are not frozen; some balance is necessary".

Policy-Educational Access

"Who qualifies as an educational authority?" the Commission asks.

"What extra equipment can be demanded by educators in a franchise agreement?"

Answering their own question, the Commission allows "educational authority was not meant to restrict use of this channel to the local public school board. Any school, college or university, public or private, formal or informal, should have the opportunity to program this channel".

An exception: "any commercial activity enterprise (computer school, beauty school, etc.) would not qualify".

And, "it is not the cable system's responsibility to program this channel". The matter of "free equipment" will be dealt with separately.

Policy — Leased Channels

The Commission has pre-empted this area of rate regulation.

"Many (local or state) authorities are already talking about regulating leased channel rates and / or rates for pay cable services. **It is premature to regulate along these lines".**

In effect, cities and states have now been told to keep their hands off of rate regulation for leased (or pay cable) channels.

Policy — Technical Standards

The Commission has taken some heat from cities (and

states) which have attempted to re-regulate technical standards. Usually standards proposed by cities (or states, such as New York) have been far more stringent than those established by the Commission.

"A petition for rule-making regarding federal preemption of technical standards has been filed by the NCTA (RM-2196, filed 5-23-73)".

Accordingly, the Commission **"invites comments to Notice of proposed Rule Making 20018 on the question of whether cable television technical standards should be totally pre-empted or a moratorium on additional non-federal technical standards should be imposed".**

This is an opportunity for all interested parties to state facts and opinions; which will assist the Commission in ruling on this important question.

Policy-Fed / State Relations

The Commission shows concern for the developing role of states in CATV regulation. They state, "We intend, in the near future, to deal with this question. For now it should be sufficient to caution all regulatory bodies involved or considering involvement in cable television that **we** (i.e. the FCC) **are concerned about the developing duplicative and burdensome overregulation of cable television".**

Policy — Franchise Authority

In 76.31 (a) it is required that a CATV system have a Certificate of Compliance to begin operations; and to receive a Certificate, a system must have a "franchise or other appropriate authorization".

It must not necessarily be called a "franchise". It **"may take the form of a franchise, franchise and ordinance, license, permit, certificate of convenience, etc."**

"Documents showing authorization from the appropriate local authorities must be complete before a Certificate of Compliance application will be processed."

"All local (and state where required) processes must be completed; the Commission will not process a CAC application until this has been done".

The Commission notes that in some areas, particularly in county regions of states such as Texas, South Carolina, etc., **"there has been some difficulty when there is apparently no appropriate authority in the state empowered to grant a franchise".**

The Commission has, in such cases, "granted Certificates when an alternate proposal is supplied" and **"when a formal statement has been supplied by the local authorities"** to the effect that **"no local authority is empowered with the authority to grant such a permit (etc.)".**

This Commission has again asked those states where no such authority exists "to clarify this situation at the state level in the near future", because "we have no desire to become involved in the interpretation of state laws".

Another minor problem that has come up is the situation where the franchising authority refuses to grant a franchise; to anyone.

"When a franchising authority declines to grant a franchise, alternate proposals submitted by a (prospective) cable operator will not be accepted. Where a franchising authority has the power to grant a franchise, but declines to do so, a Certificate of Compliance will not be issued."

Policy — Franchise Standards

76.31 (a) sets forth the minimum standards which a franchise (ordinance) must follow.

"We have allowed applicants to remedy minor deficiencies by official communications from franchising authorities". Such less-than-formal process has "allowed us (FCC) to administer our rules with flexibility". But that is not to say "substantive omissions can be corrected in this manner".

"For instance, a statement that a full public proceeding was held is not included in the franchise" but "we find that in fact one was held," we will "not reject the application".

"We intend to apply our rules reasonably, on a case-by-case basis" but **"such** (extra) **considerations will unavoidably slow the certificating process".**

Here the Commission is re-affirming its willingness to work with an applicant to correct some minor point in a franchise (ordinance) but points out that when an application requires "special handling," that the time between submission of the application and grant of the CAC is lengthened.

Policy-Public Proceedings

"Prior to the selection of a franchisee, the franchisor investigates the applicant's legal, character, financial, technical and other qualifications".

"We also require that the public be granted an opportunity to become involved in the franchising process. Smaller communities (as a rule) confine the process to regular city council meetings".

The purpose of the present rule is to assure that the public has been given the right to be heard.

The Commission notes "we do not intend to act as a 'court of last resort' " and "if local officials assure us that they have made appropriate investigations of the franchisee's qualifications, we will not delve further into the particular decision".

In spite of this posture, the Commission has been asked to strengthen the rules.

One group asks that the Commission "articulate minimum due process standards".

The Commission states "we are not sure that such an approach is practical in the dual jurisdiction program we have set out".

Nonetheless, **the Commission "invites comments on Proposed Rule Making Docket 20019",** as follows.

"Should franchising authorities be given specific guidelines and requirements on the information to be considered prior to selection of a franchisee"?

In the same area, the Commission addresses itself to the matter of setting procedures for franchise renewals; a matter that has been causing considerable concern amongst existing "grandfathered system operators".

"Do the current rules on public proceedings include franchise renewals?"

"The simple answer is yes".

However, "we do not require that there be written bids or even that there must be competitive proceedings. Particularly in renewals there may be no reason for competitive bidding".

More about renewals and the position of the existing system operator shortly.

Policy — Line Extensions

"It is our intent that all parts of a franchise area that could be reasonably be wired would be wired".

The Commission was initially concerned that franchisees would wire "desirable portions of town first" and "leave unserved less desirable portions". To the Commission, inner-city-cores might be the last to be wired. Now the Commission is finding the opposite may be true; i.e. the more suburban (less dense) areas are not being wired.

"Clearly, this problem can best be dealt with on the local level," the Commission notes.

"The ideal case is where a franchisee is required to wire all of the franchise area."

"We are aware that franchises are being granted which do not encompass the entire political sub-division. Such grants are appropriate so long as they do not deprive certain portions of the population from service. This would be unacceptable if marginal areas are left out of the franchise area to protect the CATV operator."

"Other jurisdictions define the franchise area with a 'line

extension clause' where the CATV operator is only required to wire portions where specified numbers of homes exist per mile. Numbers we have seen range generally from 30 to 60 homes passed per mile."

"A middle course follows a formula that allows outlying pockets of viewers to request service if they are willing to pay the (specified) costs of extending the trunk line".

"We can see reasonable justification in all of these approaches. We recognize the problem, and will continue to grant Certificates of Compliance to applicants which do not fit our ideal (i.e. wire everything) **provided we have assurances that those citizens directly affected by the exclusions or conditional wiring provisions are informed of the effect of such provisions before they are adopted".**

Unfortunately, many line extension policies were arrived at "without any consultation with the citizens involved; often even the franchising authority does not fully understand the effect of its actions".

Accordingly "we require that there be a showing that such formulas were arrived at knowledgeably and publicly."

Since this type of assurance and language does not presently appear in Part 76, the Commission is **inviting comments on Docket No. 20020; which will deal with modification of Part 76 to deal with this problem.**

Policy-County Wide Franchises

"Clearly a large **county** with many non-contiguous pockets of population does not expect one franchise to wire the entire county." "We (the FCC) have consistently contacted applicants for Certificates of Compliance with blanket county franchises and requested more specific information on what areas of the county will be served. **CAC's will only be granted for those specific areas and not for an entire county,** unless the applicant truly intends to serve the entire area within a specified construction time schedule."

"It would be a significant help if county governments designated discrete communities (or areas) in their franchise grants".

Policy — Service Extension

"One of the most common complaints (received by the Commission) is a potential subscriber's inability to receive service.

"This generally is caused by one of three situations:

"There is a system, but it will not extend its lines;

"There is a system in an adjacent (political) jurisdiction but it cannot extend its lines into the other jurisdiction;

"There is no system in the area.

"In the case of a system refusing to extend its lines, the policies set forth in our previous discussion of line extension matters establishes the procedures.

"In the case of no system in the area, the community should seek a qualified applicant for service.

"In the case of adjacent political sub-divisions, we have a vexing problem.

"Newly developed areas, housing developments, find themselves unable to receive service because they are on the fringes of a franchised area, or just outside of a franchised area.

"Extension of service with existing systems (may be) an economic or engineering impossibility".

The Commission proposes "where there are pockets of population or growing suburban sub-division, (we) urge the communities through their franchising authorities to join together in planning for future cable development".

"We have seen several cases where a new housing development was unable to get cable service because it was on the extreme edge of its community, but an adjoining jurisdiction's cable system was readily available."

"Service extension and the delineation of the franchise (area) should be one of the primary concerns of local regulatory authorities. It has received too little attention in the past".

Policy-Franchise Term

"Rules limit the length of a new franchise to 15 years (76.31 (a) (3).

"Lengthy franchise grants are an invitation to obsolescence in light of the momentum of cable technology".

It has been suggested "this rule be changed in favor of a more flexible approach; larger cities may require as much as 25 years" to amortize the initial debt.

"The problem of minimum franchises has also been raised: we understand that in some states it is easier to secure a year-to-year franchise than a term franchise which requires a public referendum".

"However, year-to-year franchises impose significant risks and increase administrative burdens. We intend to consider imposing some minimum franchise term, say five to seven years, to remedy the problem."

The Commission is **inviting interested parties to submit comments on Docket 20021: in both the area of extending franchise terms to beyond 15 years, and to establish a minimum period of 5-7 years.**

However, "of particular interest would be any cash flow figures supporting contentions for the need for longer franchise terms".

Policy — Franchise Renewal and Modification

"The entire subject of franchise duration, modification, renewal, expiration and cancellation is one fraught with difficulties".

"A franchise calling for a 15 year term with a renewal option at the sole discretion of the franchisee does not comply with the rule."

"The franchisor must at least review, in a public proceeding, the performance, adequacy and consistency (of the franchisee) with our rules prior to renewal".

"This is not to say that any bid procedures are required or that any new franchise offering must be made, but simply that a public review of the franchise must be held with the opportunity for citizen input prior to renewal."

Be advised, however, that a Certificate once granted "does not apply to renewal franchises or to franchises which are significantly modified".

"Substantial change (in the terms of the franchise) is considered as effectively terminating the original (certificated) franchise; and requires recertification."

"An exception to this doctrine is a change in subscriber rates. Such a change is consistent with rules that require a public meeting."

The Commission explains "our entire program of Certification would be meaningless if significant alterations, potentially contrary to (our) rules, could be made in a franchise after we had certified that it complied with Federal regulations.

"Any substantial change in a franchise would automatically end any 'grandfathering rights' regarding other provisions in the same franchise. Our 'grandfathering' of pre-March 31, 1972 franchises was intended to give franchising authorities a reasonable amount of time to bring franchises into compliance. If they are now changing provisions, they have also had ample opportunity to acquaint themselves with the new rules and will be expected to comply with all of the franchise requirements."

Policy — Expiration and Cancel

The Commission is expressing concern over situations where "franchise renewal applicants threaten to terminate service to the public rather than reach an accord with the franchising authority".

Two problems in this area bear mentioning.

"First as the franchise term draws to a close with no

assured renewal or fair compensation in sight, **the cable operator acquires a strong disincentive to invest in needed new equipment that he cannot be certain of amortizing over the remaining term;** the result is an obvious deterioration in service."

"This situation has in the past created extreme and sometimes unwarranted pressures on the franchise authorities and system operator to reach renewal agreements.

"There should be no cancellation or expiration of the franchise without fair procedures and fair compensation. The existing franchisee should be given adequate notice and an opportunity to be heard.

"If the decision is adverse to the existing franchisee, the franchisor should have some provisions for an assignable obligation to acquire the system at a pre-determined compensation formula. In the case of non-renewal payment (should be of) fair market value of the system as a going concern; in the case of cancellation of the franchise for material breach of its terms, the compensation criterion might call for depreciated original cost with no value assigned to the franchise."

The Commission is suggesting that this kind of franchise (ordinance) language be written into any new (or re-newed) ordinances (franchises).

The Commission further notes **"Our concern is so great** (as relates to continued service to the public) **that we are considering adopting rules requiring franchises to contain specific provisions and procedures relating to expiration, cancellation and continuation of service".**

Under Docket Number 20022, the Commission is inviting comments on the entire question of how the franchisor and franchisee can be afforded adequate protection in this vital area.

Policy-Transfers

The Commission is also concerned about "transfers or assignments of control of franchises".

"Many questions have arisen" and we note "most new franchises require local approval before transfer can take place".

The Commission assumes that such approval is given only after public proceedings. **Such a requirement is not presently included in 76.31 of the rules.**

The Commission, in a proposed rule-making docket, asks "what constitutes transfer of control?"

"If corporate ownership changes by acquisition, merger, etc. yet the local franchisee stays the same, should this trigger a public proceeding?

"What effect would such an interpretation have on the ability of multiple system operators to consolidate, merge, etc. in the open market place?

"The question has been asked whether franchise transfer constitutes a significant change so as to require recertification? At the present time it does not. It would seem that as long as the franchise terms comply with our (FCC) rules and the franchise is certified, it (would be) unnecessary for us (FCC) to require recertification.

"While we do not require recertification, **we are considering adding a provision to our filing requirements (calling for) the submission of a new Form 325 for any transferred system."**

"When we receive this information, we would check the new Form 325 for compliance with our cross-ownership rules. A statement of such compliance accompanying the submission might also be required."

Here the Commission appears to be invoking its own thought processes and **asking for comment (on Rule Making Docket 20023)** on what they describe as "a difficult area that requires careful study and perhaps additional regulation".

Policy-Subscriber Rates

76.31 (a) (4) requires that for a system to receive a Certificate of Compliance, **the system must have a franchise providing for franchisor approval of initial installation charges and regular subscriber service** (charges).

The Commission notes "We (FCC) have intentionally and specifically limited rate regulation responsibilities" to the local franchisor.

The Commission has further **defined regular subscriber service** as that service regularly provided to all subscribers. This does **not** include specialized programming for which a per-program or per-channel charge is made.

The Commission is now concerned that various local (and state) agencies seek to regulate rates in these two areas (per channel and per program). To thwart such local or state activities, the Commission is stating **"we have concluded that there should be no regulation of rates for such services at all by any governmental level".**

The Commission continues "We are preempting the field and have decided **not** to impose restrictive regulations."

In effect, notice has now been given to everyone attempting to get into rate regulation in this arena that the FCC will reserve that area for its own regulative activities; **when they deem it necessary.**

Policy-Subscriber Complaints

"Assuring that subscribers receive quality service and quick resolution of complaints is one of the most important regulatory functions to be performed at all levels of government.

"The primary responsibility is at the local level," however.

"Many franchises are now being reviewed which have full statements of the franchisee's obligations to resolve subscriber complaints **but no indication whether the franchisor has any obligations.**

"We wish to make it clear that this obligation was meant to cover both parties.

"In order to fully comply with 76.31 (a) (5) franchising authorities **from this point on will include specific provisions in the franchise on what government official will be directly responsible for receiving and acting upon subscriber complaints.** We would also urge that this information, along with the specified procedure for reporting trouble to the cable operator, be given to all subscribers as they are hooked to the system. Some communities have required that a card with this information on it be given to each new subscriber. It seems to have worked well and **we would encourage adoption of this approach."**

Here the Commission is putting the franchising authorities **on notice** that future franchises (ordinances) must include full local city recognition of the city responsibility to handle problems with service, on a local level, including designating someone at the city to receive subscriber complaints.

The Commission also seeks to clarify the matter of having a **"local business office"** in each community served.

"The operator of a single plant multi-community system need not have a business office in each community so long as the subscribers can call a local (i.e. non-toll) telephone number to register complaints.

"We (FCC) will not accept a situation where there is only one business office in a large county (requiring) long distance telephone calls for subscribers to register their complaints."

Parties interested in commenting on the proposed modification of 76.31 (a) (5) (as it relates to modification to make cities more aware of their local complaint responsibility) should file comments on Docket 20024.

Policy-Franchise Consistency

Section 76.31 (a) (6) puts the municipality on notice that if the FCC adds, modifies, changes rules which have a direct affect on the franchisor / franchisee relationship, that the franchisor has one year in which to update its franchise to add the new provisions.

This is, in effect, an automatic updating process which allows the Commission to be certain that as the regulation scheme for cable matures, that all franchises with certificated cable operations will "stay current".

"It should be understood that any required modifications would have to be made even where a franchise does not specifically state that it is amendable to comply with our changes (within one year)".

Policy-Franchise Fees

"76.31 (b) sets a limitation on the franchise fee deemed acceptable in an application for Certification of Compliance".

"The figure of three percent of gross subscriber revenues seems to more than adequately compensate for the average franchising authority for actual regulatory costs. We have provided a waiver mechanism for fees up to five per cent in those cases where an unusual or experimental regulatory program is proposed and it can be shown to need the extra revenue."

"The term 'gross subscriber revenues' is meant to include only those revenues derived from supplying **regular subscriber service;** that is, the **installation fee, disconnect and reconnect fees, and fees for regular cable benefits,** including the transmission of broadcast signals, access and origination channels, if any.

"This does **not** include revenues from per-program and per-channel charges, leased channels, advertiser revenues, or other revenues from the system.

"We (FCC) recognize that income from auxiliary cable services may at some future time constitute the bulk of a cable system's receipts.

At some future date, a limit on "gross subscriber revenues may be lifted".

And, "We suggest that franchising authorities write their franchise fee flexibly using gross subscriber fees (as defined here) as a base for now, but including a provision for the base to change to 'gross revenues' automatically in the event that (the) Commission changes its rules."

"There have been several cases where a franchise fee has been based on something other than gross subscriber revenues. Where this fee is based upon a set fee per year per subscriber, generally, we will attempt to translate this fee into a percentage of gross subscriber revenues to see if it reasonably complies with our rules."

Policy-State / Local Fees

"Both state and local fees will be added together to determine compliance with our fee limitation".

In effect, if the state takes 1% of gross revenues, the city will then be limited to a maximum of 2% (1 + 2 equals 3% maximum allowed).

"Several jurisdictions are attempting to impose a 'use tax' as well as a fee for cable television service.

"We think it necessary to voice our concern about this development; the burdens and obstructions (to growth) remain the same whether imposed via a fee or a tax."

Policy — Fee Waivers

"A waiver of the three percent maximum franchise fee is available.

"In the rare case where a more comprehensive regulatory program is contemplated, the extra fees might be justified. In particular, in larger markets where experimental applications of cable are being attempted, our three percent

fee limit might not cover the costs incurred.

"Petitions to justify fees in excess of three percent' should include both a full description of the special regulatory program contemplated, a full accounting of the estimated costs, estimated subscriber penetration, and the derived figures on (fee) revenue anticipated from the franchise fees.

"Recitation of the **normal obligations to oversee a franchise** assumed by the local authority is **not sufficient** to warrant the extra fees.

"Simply allocating a portion of the time and salary of the various city officials will also not be considered sufficent.

"Such an allocation without amplification would only confirm that the fee is being used as a revenue-raising device for the (city) **general treasury."**

The Commission is going on record as being soundly in favor of a maximum fee schedule of three percent except in every unusual "experimental" circumstances. And anything that looks like the CATV franchise fee is being used for **general revenue raising** for the city treasury is going to be given a hard look.

Policy-Lump Sum Payments

"Included in our (FCC) limitation is a notation that lump-sum payments (or payments in kind) would negate the effort to limit the franchise fee.

"The public would be the ultimate losers, since the franchising authority and bidders would focus on bidding rather than how and by whom the best service can be provided to the community.

"Such payments are amortized (by the FCC) over the term of the franchise to determine their effect on a percentage figure".

In effect, if the franchisee is agreeing to pay the maximum non-waiver amount of 3% of gross revenues, **any lump sum payment** (even if spread over 15 years) would push the fee over the 3% maximum allowed.

"One **exception** to this method is consulting fees and expenses incurred in the granting of renewal of a franchise. If these fees are not excessive and can be shown as direct costs to the franchising authority, they should be recoverable from the ultimate franchisee or from all franchise applicants.

"So long as these expenses do not become a new form of bidding, we will not include them in our calculation of (maximum allowable) franchise fees. We will (however) continue to watch for evidence of abuse."

Policy — Extra Service Packs

"Another area that we closely monitor is **extra services**".

"This has included everything from free wiring of entire school systems to the building of television studios attached to the local high school to the addition of extra free channels, fees for access groups, and even free television sets for city officials."

"In many franchises, the franchisee is required to install **one** free 'tap' or 'drop' in each local school, and often in every other governmental building (city hall, fire houses, etc.). **We have no objection to this provision."**

"Some franchises have required the cable operator to wire each room of a school or all schools free of charge. This sort of indirect **payment-in-kind** will not be allowed without justification.

"All parties must recognize that when such costs are incurred, they of necessity often become trade-offs on service provided elsewhere to the community at large. **In this example we merely have the cable operator subsidizing the school system.** That is not his function."

"A trend seems to be developing where franchising authorities specify in the franchise production equipment to be made available.

"We do not think this is a particularly good idea. Origination will not work because of anything written into the franchise. It is far more important to write strict franchise provisions. Their mere requiring of specific cameras and equipment will not guarantee successful community access.

"If the franchising authority wishes to specify the service package, we (FCC) will not stop him from doing so.

"Both franchising authorities and the franchisees must recognize that specification of service packages will reflect upon the cost of the over-all service to the community. **Excessive demands affect the viability of the system.** Cable operators must learn that accepting such demands simply to secure a franchise may not be in the cities' best interest.

"The net effect of some superficially attractive packages might be a basic system that does not find it possible to serve the community properly.

"It has been our policy **to date** to view any service packages in relation to franchise fee limitations.

"We plan to **relax** this approach experimentally. The service package — so long as it is directly related to services and equipment which can benefit all cable users — **will now betreated as a contractural question,** and so long as the package is not clearly excessive, solely at the discretion of the franchisor and franchisee.

"Any evidence that cable operators or franchisors are using this relaxation to return to the damaging process of simple **bidding contests** will result in immediate reinstitution of our former procedures.

"It should be noted that if the operator is required to wire the entire school system for closed circuit cable use, this will still be considered payment-in-kind".

In effect, if the equipment to be supplied will benefit **all** cable users, it will probably be considered contractural in nature. If it benefits **one** narrow segment of the community (school system, an access group, etc.) it will be considered **payment-in-kind** and will be subject to the franchise fee limitations.

Policy — Other Fees

"Proposals have been made to use part of the franchise fee to defray costs of access programming, local educational television broadcast facilities (etc).

"We have stated that the franchise fee should be utilized for (and based on) regulatory costs. **It should not be used for revenue-raising purposes.**

"We will (however) entertain requests for waiver of this provision for the use of franchise fees for non-regulatory purposes. **Such requests must be very specific.** Information on how the funds will be used, distributed and accounted for must be included. A statement that the proposed use of the fee is consistent with our regulatory program and will benefit the development of a broadband communications system will also be necessary.

"Extra fees will be limited to the same maximums now imposed for regulatory purposes, five percent of gross subscriber revenues.

"It is unlikely that we will allow waivers for any proposal that exceeds a total of five percent for regulatory and non-regulatory purposes.

"Proposals that wish to use the two percent **pad** between three and five percent for public access purposes pose several problems.

"We intend to issue a separate document that will address this specific issue. **There are serious difficulties, we feel, with governmental funding of (local access) programming.**

"We (FCC) intend to be vigilant and monitor any requirements for (added) franchise fees or (added) services, to assure that no undue burdens are being imposed that would result in a diminution of the overall goals set for cable television.

"Cable television must be allowed to grow in stages or it will be killed by overexpectation and excessive demands".

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(1) Each of the seven dockets are being considered separately and comments must be limited to a single docket number; if you wish to comment on more than one docket number, handle each docket comment separately.

All interested parties are invited to file written comments on one or more of the proposed rule-making proposals (see text) on or before June 7, 1974.

Reply comments will be due by June 21st, 1974.

An original and 14 copies of any comments must be included with any filing, to satisfy Commission requirements.

LATE FCC NEWS

Due dates for the dockets discussed in this month's Cable Bureau Communique report have been modified by the FCC.

Announced May 6th, the following dates for dockets discussed apply:

20018 - Technical Standards, comments now due August 2nd.

20019 - Franchisee Selection, comments now due July 26th.

20020 - Line Extensions, comments now due June 28th.

20021 - Franchise Duration, comments now due July 5th.

20022 - Franchise Expiration, comments now due July 19th.

20023 - System Transfers, comments now due July 12th.

20024 - Compliant Procedures, comments now due July 28th.

Additionally, Docket 19995 (network exclusitivity) has had comments rescheduled until June 17th.

CABLE DROP

OOPS DEPARTMENT

A couple of minor transgressions slipped into our May 1974 issue of CATJ. For the record, they need to be corrected.

PAGE 13 — The text calls for a 0-500 microamp meter while the schematic of the noise indicating meter shows a 0-500 milliamp meter. Should you be confused, microamp is correct.

PAGE 33 — Diagram 1-A shows the marker source and sweep source being mixed in a combiner ahead of the input of the unit under test. Every good technician knows the marker is added to the sweep display after the unit under test.

PAGE 44 — Under equalization paragraph, the last sentence should read . . . "i.e. Cable losses approximately double every time the frequency is quadrupled."

CATJ'S WALL CHART TELLS IT LIKE IT IS!

Every conceivable off-the-air head end problem has been created in the CATJ lab, and picture-tube-screen photographed. Each is explained in the text with the more than 90 photos on the wall chart. Subject matters include signal to noise ratios, signal to noise-interference ratios, signal to co-channel ratios, antenna patterns, ghosting, noise sources and their identity and much more.

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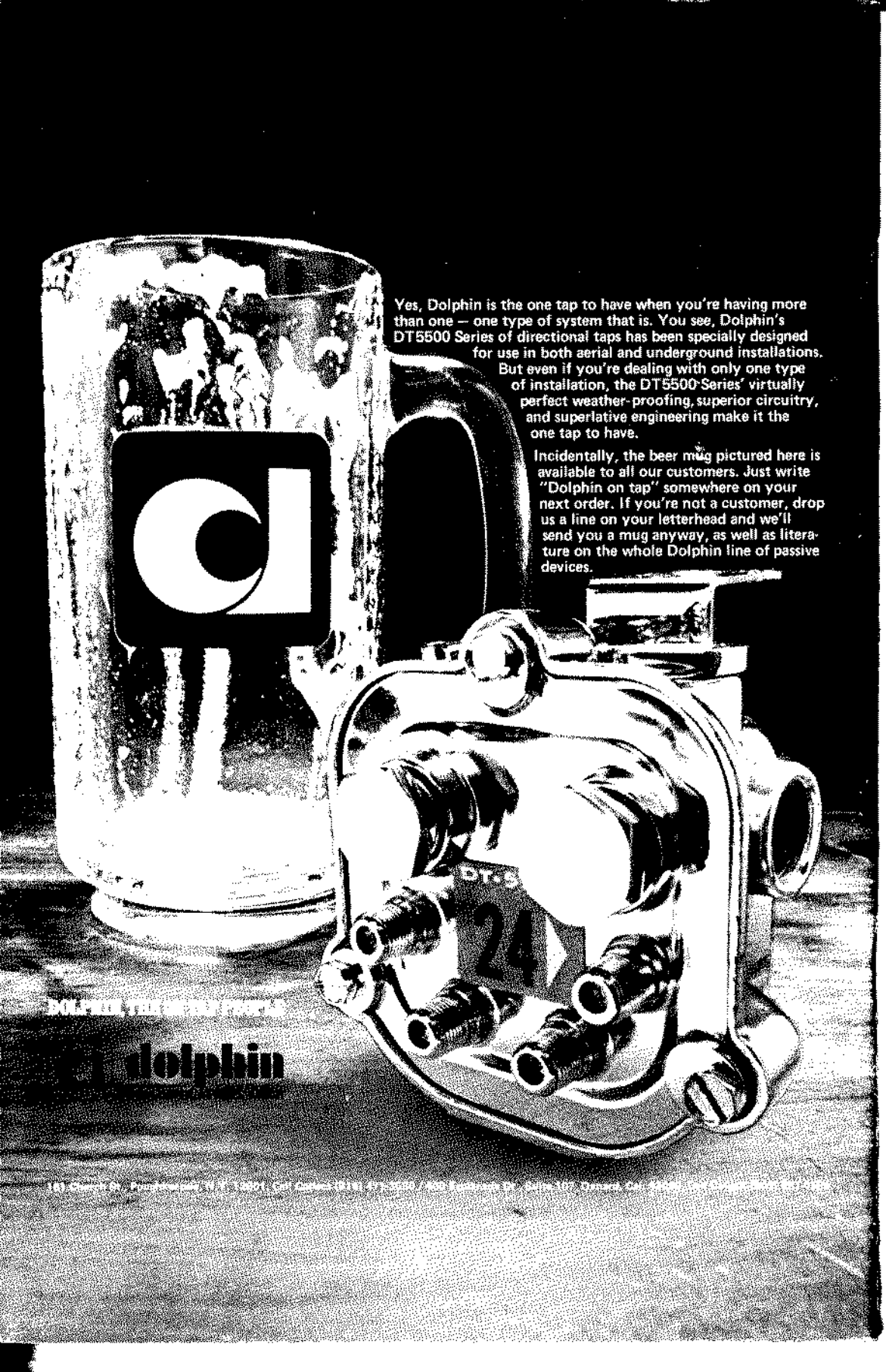
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Incidentally, the beer mug pictured here is available to all our customers. Just write "Dolphin on tap" somewhere on your next order. If you're not a customer, drop us a line on your letterhead and we'll send you a mug anyway, as well as literature on the whole Dolphin line of passive devices.
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