CATJ

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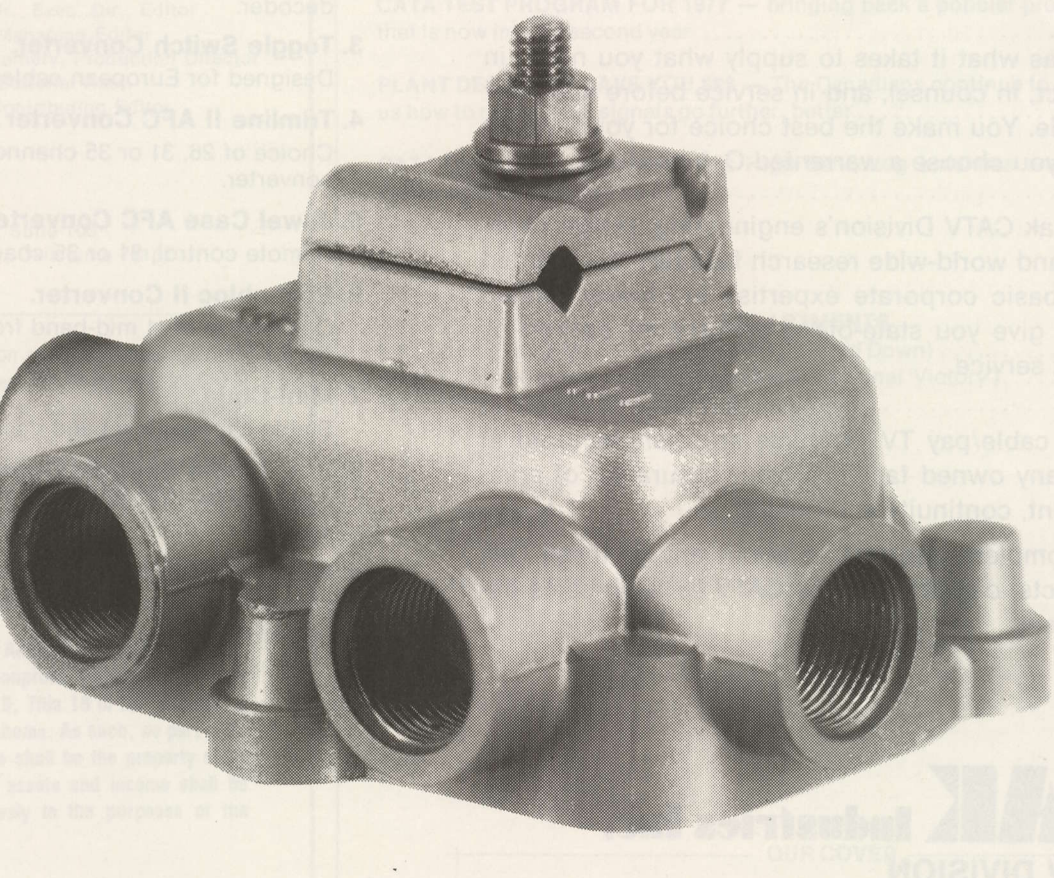

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CATJ

JAN 1977

VOLUME 4 – NUMBER 1

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

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OUR COVER

Well, we did it. Small earth terminals for CATV are approved. Editor in Chief Bob Cooper finds Atlanta's channel 17 programming fascinating in Oklahoma (they are now on the air via the bird) but (honestly) not using the "small" antenna shown in his hands on our cover. See Coop's Cable Column, page 45 here for the inside story of how it all happened.

CATA-TORIAL

KYLE D. MOORE, President of CATA, Inc.

Letting Our Guard Down

There is cause for **temporary** jubilation in the cable camp. In a series of end-of-year and end-of-tenure moves, the Federal Communications Commission has freed some of us from several different forms of bondage. First there was a reprieve from the March 31, 1977 franchise deadline. Then there was the lifting of the ban against small CATV earth terminals (see **Coop's Cable Column**, page 45 here). Which was followed by the decision to allow Atlanta's channel 17 (WTCG) to assume the needed common carrier status for its satellite distribution network.

Those of us who have labored hard and long to turn back bureaucratic power abuses of our modest, insignificant master antenna businesses can take some pride in the collective efforts that went into each of these "victories". But we are hardly out of the woods yet and this is no time to turn away from the remaining threats to our future existence, wherever they may be.

Much **might** be made of the rush of last minute business done by FCC Chairman Wiley, as he heads for the big flashing sign marked "E-X-I-T". Why this man should suddenly give cable an above board fair shake only after his own future as a communications regulator has drawn to a close is. . .frankly, beyond your speculative powers. Yet **the why** is exactly what must concern us now as we are about to enter into a new, unknown and even un-named regulatory era under a new Chief Executive and a re-structured FCC.

If this industry learned nothing else in the past year, it did learn that politics make the Washington world go around, and by whatever fashion or in whatever form, political "friends" are good friends to have. Starting at the top, President-elect James Earl Carter is an unknown factor in communications. **If** one was prone to believe utterances of brother Billy Carter, one would **suspect** that down deep Carter carried a certain amount of malice and contemptousness for the existing broadcast structure in this nation. Brother Billy believes all of the media, but television in particular, is troublesome and "too big for its britches". **If** the President shares **any** of these beliefs (and there is **not** the slightest sound indication he does), then the broadcasters and the networks could be in for some tough years ahead. A federal Justice Department determined to give the networks fits would have no shortage of material from which to work.

Cable's impact on any portion of the Carter past is unknown. Frankly, we just have not played that important a part in his past, so if we get any attention (positive or negative) in the near future, it will probably be because (1) we present an alternative to broadcasting (and that **assumes** that Carter has **any** resentment for the existing broadcast structure), or, (2) because somebody close to him, within his present or future staff, takes an interest in our well being. Like we said, nobody knows. . .**simply because there is nothing to know**; yet.

After the President, the next stop for us in the Executive Branch is the presidentially appointed head or chairman of the FCC. Who will he be? Or more important, **what** will he be? As this is written in mid-December, most of the conjecture about finding a replacement for Chairman Wiley centers around finding someone with extensive engineering and/or common carrier experience. There just **may** be such a person currently working **within** the FCC. Or there may be such a person in industry, say connected with MCI or one of the other broadband bulk message delivery firms. There may even be somebody within the cable industry who fits such an outline. Or, all of this mid-December conjecture may be a smoke screen leading down a blind alley.

Until we know who the new FCC leader is, we cannot begin to **guess** how this new leader will adapt to the myriad of practical problems facing cable television as we head into the last 23% of the 20th century.

All of which leaves us guessing, and uncertain, as to how **our** future regulatory problems may develop, on the Executive branch side of government. The same can hardly be said for our immediate future over on the legislative side of the equation.

Although Congress adjourned early in October after finding itself unable to pass a cable fine and pole bill (but adopting a new copyright bill that includes cable for the first time), and will not reconvene until after this is in print, their adjournment has hardly prevented things from happening. With the new session of Congress will come no fewer than two cable bills, and a couple of cable-related bills. And there will be hearings on a massive re-write of the communications law of the land; the act of 1934. If there is a measure of unknowns over at the Executive Branch of Government, vis-a-vis cable TV, there is little on the legislative side. When the 94th Congress adjourned, proponents of a "pole bill" for cable said **they would be back**. Early in the new session. We must take them at their word.

When the 94th Congress adjourned, there was every indication from both proponents in Congress and over at the FCC that a fine and forfeiture bill (standing alone, without poles) would also be back, early. There have been no substantive changes in the makeup of the various committee groups that will consider this type of legislation, as a result of the recent national election. So the people who were in place when Congress adjourned will be pretty much in place when they reconvene. It looks like business as usual.

Cable related bills will include a possible bill to change the status of VHF and UHF translators; if the FCC does not take some action of its own prior to that time. Another cable related bill will surface in the area of permitting funding of rural cable type systems by some federal agency, and REA is a front runner for this "honor".

But the big daddy of them all will be the complete (they say) revision of the Communications Act of 1934. There are various estimates of how long this may take. Congressman Van Deerlin, perhaps only partially serious, has been quoted as suggesting "it may be done by 1984". Others, more optimistic, are saying it is a two-year project, and they speak in terms of a 1979 completion date.

Cable's part in the bill is relatively minor; in the scheme of how complex the act itself is likely to be. The 1934 act, adopted at a time when communications was simple and special interest groups such as broadcasters hardly well entrenched as effective lobbying forces, was really a codification of an act first written in 1927. **It took seven years in that era** to put the '27 (Radio) act into final form. That does not suggest much hope for a two year time frame this time around.

Cable's role in the early days look to be largely advisory. **A ten person advisory board** has been formed, with representatives from virtually all facets of the CATV business. CATA's representative to this advisory group, General Counsel Richard L. Brown, is likely to be attending sessions for the group until his six year old daughter is well into high school.

This is no time to let our guard down. Rather, this is the time to be forging ahead with postive programs to make ourselves known as business people with an interest in politics and an interest in helping our elected representatives reach their constituentcy. **That is the only way** you will get the ear of a "voter in Congress" **when you need him** to listen to your side of a problem. This is a fresh new start with a whole new ballgame. Let's all get out there and make our individual voices heard this time around. I have the feeling that before this game is over, we are going to need every member of our cable team in the game.

CATV's TEST EQUIPMENT HOUSE

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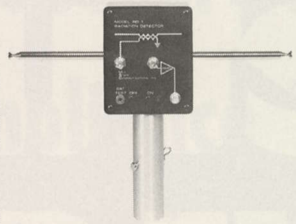

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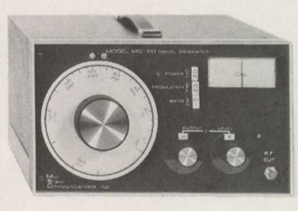

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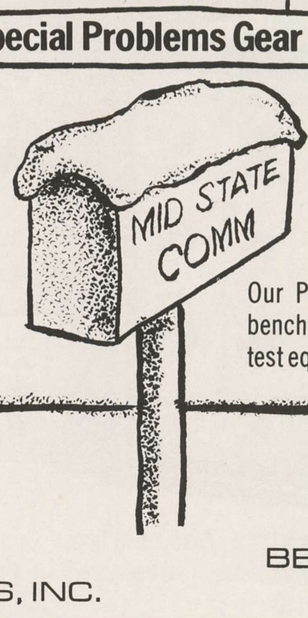

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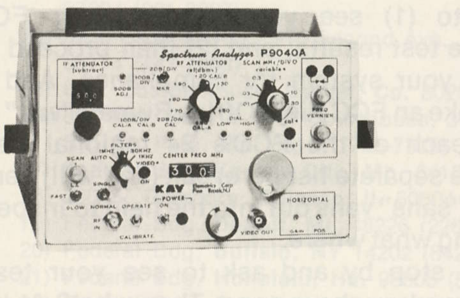

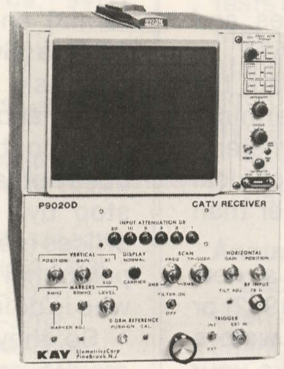

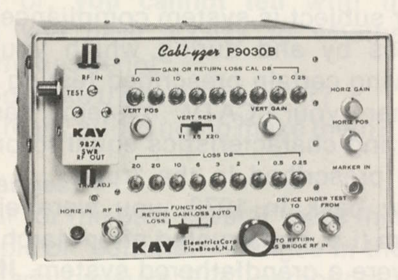

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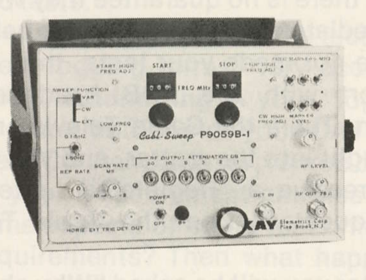

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"WE SHOOT EVERY THIRD FCC INSPECTOR. . . . . .and the second one just left"

This Year For Real

Here it is the first of another year, and nearly five full years have passed since the Federal Communications Commission came along and announced a comprehensive set of rules and regulations for the federal control of CATV.

Our subject is system compliance testing, the process by and during which you determine, following certain prescribed testing parameters, whether your CATV system has technical operating characteristics equal to or better than those prescribed in the "rules".

Now back in 1973, you were either a new system (i.e. constructed after March 31, 1972) or you were a grandfathered system. **If you were a "new system",** you were supposed to make your FCC compliance tests at least once per year, and no less often than at 15 month intervals. And, when you made your tests, it was your responsibility to be sure that when the test results were written down, that the test results indicated that your system met or exceeded the actual FCC "minimums".

However, **if you were a grandfathered system** (i.e. one operating when the March 31, 1972 rules became effective), you were required to make tests at least once per year, but, your test results did not have to show compliance of your system with the FCC "standards", at least **not until March 31, 1977.**

This year the tests count. That means that this year not only are the tests required, but the results of the tests must show compliance of your system with the standards of rule section 76.605. Everyone should know what 76.605 says by now, but in case you don't, we have another look at it shortly.

So this year:

(1) On or before March 31, 1977 (but no further back than January 1, 1976), you must have made all tests required (and as outlined here);

(2) And, your system must have full compliance with all sections listed here.

And if you don't?

If you don't make the tests as required, you run the risk that sooner or later one of the growing quanity of FCC field inspection vans (there are four now, headquartered in Norfolk [Virginia], Kansas City [Missouri], San Francisco [California] and the most recent addition, out of Atlanta [Georgia]) will one day roll into your town and ask to (1) see your current year FCC compliance test results, and (2) then proceed to check out your system for compliance. And it does not take an FCC Field Office Bureau **"van"** to stop by, each of the FCC's 24 regional field offices (see separate list here) can (and will) send personnel "sans" vans out into the field to inspect who is doing what where.

So they stop by and ask to see your tests results. . .and you have none. **Then what?** At the present time, the next step would be a report from the field inspector to his immediate superior, usually in his own FOB office. They "might" re-ask you for the test results (there is always the "chance" you may have "mis-placed" the tests results, and "given ten days time you could find them"), but there is no quarantee they would take this intermediate step. If they really believe you simply have not made your tests, then they will file a report with the FOB headquarters in Washington. There the Cable Television Bureau will be brought into the matter, and you can then expect to receive a "Registered Letter/Return Receipt Requested" from the Cable Television Bureau.

In the letter you will be asked **"Why should you be allowed to continue to operate your cable television system. . .in light of your refusal to abide by the rules and regulations of the Federal Communications Commission?"** In short, you have just received step one of a "cease and desist order", and you, like Howard Cushman of Sausalito, California (see December CATJ, page 10) are headed for court.

On the other hand, **if** the FCC receives their much argued for authority from Congress to assess fines and forfeitures for rule infractions, the "Registered Letter/Return Receipt requested" you receive will be a notice of "apparent rule violation" and probably "an assessment of fine/forfeiture".

FCC FIELD OFFICES FOR 24 RADIO DISTRICTS

1) Customhouse, **Boston, Mass.** 02109 (223-6608)
2) 201 Varick St., **NYC, NY** 10014 (620-5745)
3) 11425 James Byrne Federal Courthouse, 601 Market St., **Philadelphia, Pa.** 19106 (597-4410)
4) 819 Federal Bldg., **Baltimore, Md.** 21201 (962-2727)
5) Military Circle, 870 N. Military Hwy, **Norfolk, Va.** (461-4000)
6) 1602 Gaslight Twr, 235 Peachtree St. NE, **Atlanta, Ga.** 30303 (526-6381)
7) 51 SW 1st, **Miami, Fl.** 33130 (350-5541)
8) 829 F. Edward Herbert Fed. Bdg, **New Orleans, La.** 70130 (589-2094)
9) New Federal Office Bdg, **Houston, Tx.** 77002 (226-4306)
10) Cabell Fed. Courthouse, **Dallas, Tx.** 75202 (749-3244)
11) Room 1758, U.S. Courthouse, 312 N. Spring St., **Los Angeles, Ca.** 90012 (688-3276)
12) Customhouse, **San Francisco, Ca.** 94111 (556-7700)
13) 1782 Fed. Off. Bdg, 1220 SW 3rd, **Portland, Or.** 97204 (221-3097)
14) 3256 Federal Bdg., 915 Second Ave., **Seattle, Wn.** 98174 (442-7653)
15) U.S. Customhouse, **Denver, Co.** 80202 (837-4053)
16) 691 Fed. Bdg. & U.S. Courthouse, 316 N. Robert St., **St. Paul, Mn.** 55101 (725-7819)
17) Federal Bdg, **Kansas City, Mo.** 64106 (374-5226)
18) 230 S. Dearborn, **Chicago, Il.** 60604 (353-5388)
19) Federal Bdg, **Detroit, Mi.** 48226 (226-6077)
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21) Federal Bdg, **Honolulu, Ha.** 96808 (546-5640)
22) Federal Bdg, **San Juan, PR** 00903 (722-4562)
23) U.S. Post Office & Courthouse, **Anchorage, Ak.** 99510 (272-1822)
24) 1919 M St. NW, **Washington, D.C.** 20554 (632-7000)

That's what can happen now, and what could happen later, if you simply **do not make** the required tests.

Now — suppose you make the tests, and fill out your "test logging forms" very accurately, even right down to **admitting** in your "logging forms" that (1) some portions of your CATV system do **not** meet FCC standards, or, (2) you cannot, to the best of your measurement abilities "be certain" that some aspects of some tests meet all of the FCC requirements? Then what happens when a FCC man comes by to visit, inspects your test results, and finds your "honest" notation(s) that imply the system **may not** meet FCC standards?

If the FOB man is an inspector alone, without test equipment, you may find him to be a pretty decent chap who asks if he can re-check the test results with you in that area. "Perhaps there is something I can see that you have not seen" he may suggest very honestly. The 1930's image of an "RI" (radio inspector) sucking on the stem of a pipe and sincerely interested in your problems is not lost, there are still a few such people around. If you run into such an "RI", take him up on his offer. Let your hair down and go ahead and work with him; he may have some excellent advice for you!

Or, the RI may be your standard SOB (that's **Son of a Broadcaster!**) out to "make his quota" and no matter what you say or how you say it, he has predetermined that you will be hung. In that case, you probably will be hung with our own honest "test logging" information; inspite of the Fifth Amendment.

If you happen to draw an FOB van, chances are pretty fair that they are out for blood and while certainly friendly, they are in your town with their 100 kilobuck rig primarily as a "field hunting exercise". No self respecting hunter comes back empty handed.

The bottom line is that you are in double jeopardy if you get caught with no test results **and** no technical compliance, but your shade of guilt is considerably lighter when you have made the tests and have indicated (honestly and accurately) that the results do not always conform to FCC standards, or, **you cannot tell** with the test equipment you have access to whether your system complies or not.

So do you make the tests this year?

Can you really afford not to make them?

Annual Changes

Each year for the past several years there have been a couple of "editorial" changes in the rules, changes made because FCC personnel receive feedback from operators such as yourself indicating that certain aspects of the present rules are troublesome or burdensome. No, not all complaints result in "editorial" rule changes. But a surprising number do.

An "editorial change" is a clever tactic middle level FCC personnel employ to get changes in the rules without going through a full blown (and time consuming) "Notice of Proposed Rulemaking". Basically, somebody wants to make a change in the existing rules. Change a number, a word, add a couple of words. The proposed change is drawn up, and circulated amongst all of the affected parties. Some of these are inside of the Cable Bureau, but a considerable number are outside; such as in the Broadcast Bureau, or Office and Plans and Policy (OPP), or in some other FCC fiefdom. After everyone concerned has "signed off", the "editorial change" is prepared in final form and released. There is no public input on such a change, save of course the original "public" input that may have started the whole thing moving.

During 1976 we had both "editorial changes", and regular "Rule Making Proposals" in the technical area. Some of the former got through by year's end, it appears doubtful any of the later did. But many if not most of the later proposed during calendar year 1976 **will** get through, we believe, before many more months drag by. And consequently we are dealing with both here.

(1) **In Channel Flatness Test Parameters** — Ef-

fective December 3, 1976, the specified frequency measurement points for in-channel flatness tests (76.605 [a] [8]) has been modified by editorial change to: Minus (-) 0.50 MHz to plus (+) 3.75 MHz.

How this got changed is as interesting as why. We'll see why later in this report. As for the why, anyone who has an **off-air** television channel with an immediate-lower (adjacent) channel signal present on the antenna knows that special precautions must be taken to keep the lower adjacent channel sound carrier (signal) from getting into the visual carrier of the subscriber's TV receiver. In a heterodyne processor, with conversion to i.f. and then back to a VHF TV channel for cable distribution, the heterodyne processor lower adjacent channel sound trap is usually deep enough and sharp enough that the lower immediately adjacent aural is controlled and does not cause herringbone interference on the desired channel video signal, unless the non-desired lower adjacent channel audio is just tens of dB stronger than the desired video signal.

But what happens if the CATV system does not use (i.e. cannot afford) heterodyne processing units? A couple of thousand systems have on-channel "strip-type" processing equipment. And in order to clear out the lower adjacent sound at the **input** to a strip, you need a deep-notch trap **ahead** of the strip. Only. . .**and this is the rub**. . .if you put a trap on the lower adjacent sound carrier, the in-channel flatness specification we have had for sometime (which for reference **was** + /- 2.0 dB from minus [-] 0.75 MHz to plus [+] 4.0 MHz) could not be met. The lower adjacent sound carrier trap simply was too broad to allow trapping on the lower adjacent sound (-1.25 MHz) without upsetting the in-channel flatness in the -0.75 MHz region.

So if you were a "strip processor" **manufacturer,** such as Blonder Tongue or CADCO, you could (conceiveably) be out of the strip business on March 31, 1977; if the FCC held to its spec. That is a hard blow to take, and it would be an equally hard blow for the thousands of systems using one or more on-channel strip processors. Ray St. Louis of Blonder Tongue Labs, Inc. made it his personal project to see if some common sense could be pounded into the Cable Bureau technical types on this one. Ray first tried to show, using the best Lab gear he could lay his hands on, what happened in the field when you put a lower adjacent channel sound trap ahead of a processor of the strip variety. He got nowhere.

Then he set the BT labs to work building a proto-type on-channel strip processor **that did meet** the + /- 2.0 dB flatness spec from **minus** 0.75 to **plus** 4.0. They made one work, but as Ray very carefully documented using a phase analyzer, **when** you got the lower sideband chopped off outside of the minus 0.75 MHz point, you created such bad phase shift **within** the picture carrier passband **on** the desired channel that the resulting picture was smeared and of much worse quality than it needed to be.

That caught the attention of the Cable Bureau technical types, who then went to some television receiver people who had a computer. The computer compared what would happen with two different sets of parameters; where the passband was minus 0.75 to plus 4.0 MHz and the CATV on-channel strip processer used very sharp, Hi-Q traps to achieve the necessary reduction in the lower adjacent sound carrier level, and, where the passband was minus 0.5 MHz to plus 3.75 MHz, but the traps for the lower adjacent aural/sound carrier were not nearly so deep or steep skirted. The computer **confirmed** Ray St. Louis's findings, and on December 3rd an editorial change was made in the rules. B-T, CADCO and others manufacturing strip amps were still in business with their products, and those of you who have bought and used on-channel strip processing through the years were home free.

The alternative would have been that **you** would have had to replace **all** of your strips with the more expensive heterodyne processors.

(2) **Subscriber Isolation Tests** — Rule section 76.605 (a) (11) states that you shall provide measurement proof that there is **no less than** 18 dB isolation between any two subscribers on your cable. Last spring, by editorial change, the procedure involving this test was subtly changed so that the test of this reality is no longer required if your 'calculated isolation' exceeds this 18 dB number.

This test means that if you were to inject a signal anyplace within the spectrum of your cable system (i.e. such as 50-220 MHz for a 12 channel system), at a subscriber's drop end of cable, and then run to any other subscriber drop on your system, you should find that **the injected signal** as measured at the **other** subscriber's drop(s) is at least 18 dB **lower** in level than it is at the injection point. The purpose of this rule is to insure that whatever may happen at a subscriber's drop (such as the drop being unterminated, or shorted, or such as a television receiver local oscillator running away and radiating signal back into the drop cable), it will arrive at another subscriber's drop sufficiently attenuated (i.e. loss) so it will not interfere with the service received by the **second** subscriber.

Now going into the calculation of 'isolation' are the following parameters:

(a) First take the cable loss between the injection point and the receiving point (i.e. RF loss in the cables interconnecting the two points);

(b) And add to it any purposeful (or accidental) isolation "loss", such as you have with and through a directional tap, hybrid coupler, etc.

Under the editorial change, if you have a directional tap and it has a minimum spec of "**18 dB port to port isolation**", you are home free. The data or spec sheet for the tap from the manufacturer becomes part of your "test logging file" and it's presence there relieves you of having to make annual subscriber isolation tests.

Pending Changes

In addition to these two actual changes since last we discussed CATV measurements, a handful of additional changes **are pending**. Last April (1976) in a **Notice of Proposed Rule Making**, the Commission **suggested** making the following changes:

(1) For technical measurement purposes only, define a cable system on the basis of a "contiguous, closed system with RF integrity throughout the whole plant" (i.e. one set of measurements, regardless of the number of "communities" served);

(2) Modify the requirements of 76.605 (a) (2) regarding frequency measurements for cable carried **translator** signals. At the present time the translator signals (which do not have to maintain the same close tolerances with their on-air operating frequency as normal television stations) **are supposed to be** on the cable-assigned frequency **plus or minus 25 kHz,** just like any other off-air TV signal.

As **CATJ** pointed out in some detail last year (December, January, etc. issues) many translators operate legally (i.e. within their tolerances); but are in fact as much as +/- 178 kHz of the normal assigned frequency for cable carriage; well **outside** of the +/- 25 kHz standard **we** are supposed to respect. The Cable Bureau originally intended to make the cable operator **not responsible for off-frequency operation when it was a translator's off-the-air tolerance frequency that was causing the problem.**

Now it appears, however, that the Cable Bureau is having **second thoughts** about this. **When** this Rule Making becomes final, it is likely that what we **may** see is a rule that says that we **are free** of the obligation of re-frequency-cycling a translator **as long as** we place the translator on a cable channel where there is **no adjacent channel** on the cable. But **if** we put the translator on the cable with adjacent (translator or non-translator off-air) signals, then we must somehow figure out how to keep the converted (or off-air in the case of VHF translators, without conversion) translators **within** the +/- 25 kHz cable frequency tolerance specified.

This may not make much sense; **you** can register **your** thoughts on this matter with Mr. Bob Powers at the Cable Television Bureau, **1919 M Street NW, Washington, D.C. 20554**. He's the guy in charge of this project at this point.

(3) The stability of set-top converters is another one of those "gee who thought of this one" rules. The rules allow you to use in your system a set top converter provided the set top converter ends up putting TV signal into the cable subscriber's receiver within +/- 250 kHz (a quarter of a **mega**hertz) of the cable-assigned frequency.

The Commission is proposing to change that standard to become a "stability standard" and not a frequency-output standard. That is, recognizing that the "fine tuning control" on set-top converters often **allows the subscriber** to move the output frequency around as much as +/- 750 kHz, the Commission is proposing to make the +/- 250 kHz standard one for stability; i.e. the AFC in the converter should hold the output +/- 250 kHz **after** the fine tuning control has been set. And again, the Commission would probably accept the specification sheet **of a manufacturer** regarding this "standard", thereby relieving the CATV system operator from making a "stability measurement" as part of his FCC compliance testing. At least that is the way the Commission thinking currently leans.

Note: Where the Commission proposes to allow the CATV system operator to "lean on" the specification sheet from a supplier as "proof" of making the "standard", the **measurement** responsibility is by-passed. However, just because you don't have to measure it at regular intervals (such as annually) does not mean that you, ultimately, are not responsible if the spec (standard) is found (after FCC measurement) to be not accurate. At that point **it becomes the system's responsibility to correct** the problem, promptly, to avoid further difficulties with the Commission.

(4) The fourth and last area proposed in April of 1976, but still not formally acted upon, regards those few situations where the CATV system operating in the same town as a television station takes a direct **video** (with audio) feed **from** the TV station at its studio or transmitter, and uses that video/audio to drive a modulator in the CATV headend. Under the proposed change, this type of feed would be included in the 76.605 (a) (9) specification; which requires that "signals first picked up within

Grade B predicted contour of a television station shall have a minimum signal to noise ratio of 36 dB".

None of these four changes are official yet. However, with the exception of the rather strange approach to making the cable operator responsible for the on-cable frequency of a translator (item 2 here), it is a safe bet that before very long all of these changes will be formal. When that happens, their effect on measurement techniques will become formal also. In the interim, we doubt very much that you would be faulted for making your 1977 tests **in compliance with** the expected changes, where they might affect you.

Test Procedures And 'The Cookbook'

For three years now **CATJ** has prepared an extensive set of step-by-step test instructions. Hundreds of systems have followed these step-by-step instructions in making their own tests. Additionally, **CATJ** has taken the in-print **CATJ** material and expanded upon that in a **"CATJ FCC Compliance Tests Cookbook"** for three years, and has made these test Cookbooks, complete with test logging forms, available for a nominal charge.

The **"CATJ FCC Compliance Tests Cookbook"** is again available this year. We have taken last year's "Cookbook" and updated it to include the changes for this year, plus, we have added several new ways to perform several of the tests; some of which are made following techniques built around the CATJ/Laufer Economy Analyzer (see September 1976 **CATJ**). This year's "Cookbook" is therefore considerably more detailed than even our 1976 "best seller", and as before, it includes the necessary test logging forms and step-by-step instructions to get you through the tests. There are several techniques described for each of the tests, including where possible tests that require nothing more sophisticated than a signal level meter and **CATJ's** "FCC Tests Wallchart". Complete information to order your own "1977 Cookbook" is found on the order card between pages 8 and 9 of this issue.

CATV TESTS - QUICK REFERENCE CHECK LIST

This is an updated and current to December 20, 1976 version of the CATV system testing requirements for all systems required to make FCC Technical Compliance Tests on or before March 31, 1977.

FCC Rule Number	Annotated Requirements	Who Applies	How	Proof
76.605				
(a) (1)	Cable carriage channels shall be the same as off-air TV broadcast assignments	Everyone except on special waivers	See (a) (2)	See (a) (2)
(a) (2)	Actual frequency of cable carried channels on VHF channels 2-13 shall be + / - 25 kHz of "zero offset" TV broadcast channel assignments	Everyone except on special waivers	Frequency counter, transfer oscillator, beating with known broadcast signal as standard	Written test result records
(a) (3)	Frequency of aural carrier reference video carrier shall be + 4.500 MHz, + / - 1 kHz	Everyone—no waivers; however, only required on cable headend remodulated broadcast signals (i.e. strip and heterodyne processed signals exempt)	Frequency counter	Written test result records
(a) (4)	Across 75 ohms of system, minimum visual signal level on any channel at subscriber drop termination shall be not less than 0 dBmV (1,000 microvolts)	Everyone—no waivers	Signal level meter	Written test result records
(a) (5)	Maximum variation at subscriber drop of + / - 12 dB in 24 hour period; maximum level difference of 3 dB between adjacent-in-frequency visual carriers; maximum level not so high as to cause degradation to subscriber's reception	Everyone—no waivers	Signal level meter with tests spread over 24 hour	Written test result records, chart recordings
(a) (6)	Aural carrier level shall be between 13 and 17 dB (no more, no less-**) below same channel visual carrier level	Everyone except as noted below (**)	Signal level meter	Written test result records

The testing information to follow is primarily **new** information; information that has not previously been published in **CATJ** or elsewhere to the best of our knowledge. Most of these techniques are either new techniques for the tests you have been making all along, or are adapted techniques reflecting changes in either test equipment availability (i.e. such as the CATJ/-Laufer Economy Analyzer which is now in widespread use) or testing standards (i.e. the in-channel flatness tests). Readers are referenced to the December 1975 **CATJ** and the January 1976 **CATJ** for a basic set of instructions involving making the required tests using previously developed techniques. If you will marry "that material" with what follows, you will have a good grasp of the testing requirements and the measurement technique possibilities current to 1977. And again, this "marriage process" has been done for you in the **"CATJ 1977 FCC Compliance Tests Cookbook"** (see card between pages 8-9 here).

Frequency Measurements — 76.605 (a) (1-2)

A television signal may not be directly measured with a frequency counter simply because of the high amount of modulation material present on the carrier. The most acceptable techniques for measuring a visual carrier are as follows:

The TV carrier is processed through a counter (stripper) processor, a device which "strips" the modulation from the carrier proper, leaving only the CW (unmodulated) **carrier behind. This carrier may then be measured using a frequency counter with sufficent frequency range, sensitivity and accuracy to meet the measurement requirement.** See diagram 1.

Or, the TV cable channel is combined through a 2-way hybrid splitter with a locally developed carrier from a signal generator. The TV receiver is utilized to display a "zero beat" condition between the TV carrier and the signal generator carrier (see diagram 2). The signal generator simultaneously drives the TV receiver (through a

(a) (7)	Hum modulation products shall be no more than 5% of the visual signal level	Everyone—no waivers	CW signal generator at headend; SLM plus VTVM or scope at field test points	Written test result records
(a) (8)	Within a TV channel 6 MHz passband, from a point 0.5 MHz below the visual carrier to a point 3.75 MHz above the visual carrier, the response (passband) shall be "flat" to within + /- 2.0 dB	Everyone—no waivers	See text—introduce flat reference signal at head-end; measure degree of flatness of same signal at test point locations	Written test result records; analyzer display photos
(a) (9)	For all Grade A or B signals taken off-air, or delivered from "A" or "B" contour pick-up point via micro-wave, signals shall have signal to noise ratio of not less than 36 dB	Everyone—no waivers	SLM measuring signal level and then noise level with processor input terminated; algebraic computation; spectrum analyzer	Written test result records; analyzer display photos
(a) (10)	This rule currently suspended for all systems (relates to inner-mod measurements)			
(a) (11)	Between any two subscriber terminals at drop termination point, there shall be at least 18 dB isolation across CATV plant RF spectrum	Everyone—no waivers	Inject test signal at one subscriber port; use SLM to measure at injection point and again at second location to determine isolation	Written test result records
(a) (12)	From any portion of cable system, including customer drops, at a distance of 10 feet on a test dipole adjusted for frequency, radiated levels shall not exceed -36 dBmV at channel 2 lowering to -48 dBmV at channel 13	Everyone—no waivers	Use radiation/leakage test dipole (with known gain broadband amp) and SLM; "Cuckoo" or "Sniffer" generator(s) and associated receivers	Written test result records; sworn statement of fact.

-The Commission is currently considering amending 76.605 (a) (6) rules so that where the cable system carries a channel with no immediately-upper-adjacent cable signal, the cable system will no longer be required to reduce the aural carrier level by the prescribed 13-17 dB. When this rule becomes effective, channels 4, 6 and 13 will automatically become exempt from this "reduced aural level" requirement (13 in the case channel J is not in use) and other channels will also be exempt provided there is no adjacent channel on the **next higher 6 MHz channel on the cable system.

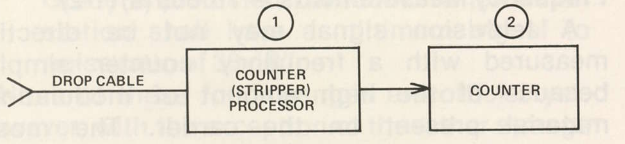

DIAGRAM 1

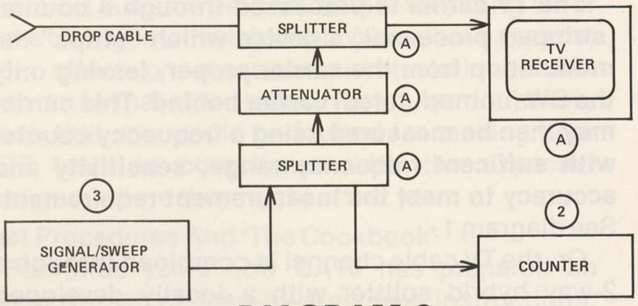

DIAGRAM 2

hybrid combiner) and a frequency measuring device such as a counter. In this case it is the frequency of the output of the signal generator (unmodulated) which is read by the counter; when the TV receiver shows both signals to be "zero beat" (i.e. **no beat bars** present — see photo 2-A), the frequency of the signal generator at that instant, as read by the counter, is also the frequency of the TV carrier. This is sometimes called a "transfer oscillator" approach; where the external beat-generating signal generator is "transferred" to the frequency of the actual carrier being measured.

This same technique may be employed with a spectrum analyzer in lieu of a television receiver. The procedure is the same as with a television receiver; the external signal generator is tuned for a "zero beat" (as indicated by the analyzer display). See diagram 3.

Another technique, employed by systems on a "thin" test equipment budget involves taking the on-cable signal and using a television receiver to beat the on-cable (converted from another channel or locally modulated) signal against an off-air broadcast signal (see diagram 4). The visual beat pattern is compared against the

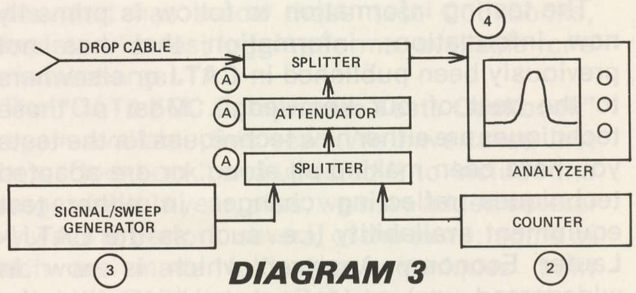

DIAGRAM 3

frequency beat portion of the **"CATJ FCC Tests Wallchart"** and a determination made of the apparent frequency difference between the two carriers from the chart photos.

Note that frequency measurement of cable TV carried channels only applies to:

(1) Broadcast (Class I) signals which are:

(A) Microwave delivered and modulated to RF at the cable company,

(B) Or, cable channels which are carried on a different channel than they are broadcast on.

Measurements are **not** required on channels carried on the same channel as they are received off-the-air (i.e. strip processors and heterodyne processors providing same channel in/same channel out do not require frequency measurements).

Aural Frequency Measurements — 76.605 (a) (3)

The aural carrier frequency is supposed to leave the television broadcast transmitter 4.500 MHz above the visual carrier frequency, with a maximum deviation of + / - 1 kHz.

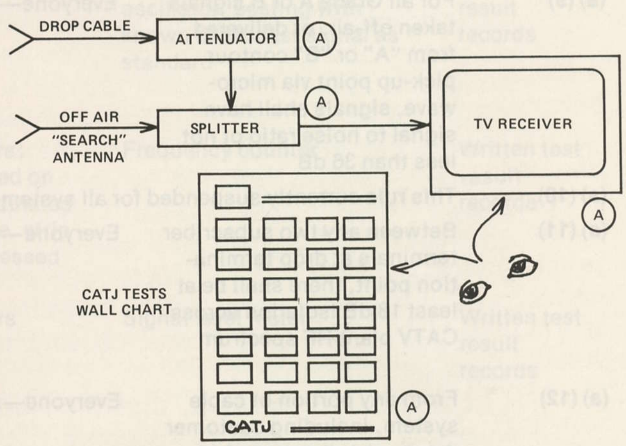

DIAGRAM 4

To measure the precise frequency-offset between the visual carrier and the aural carrier requires simultaneous measurement of the visual and aural carriers with two separate frequency measurement systems, and subtracting the visual indicated frequency from the aural indicated frequency (which should equal 4.500 Mhz), or some method of determining the "inter-carrier" relationship between the two signals.

If you utilize a counter (stripper) processor, such as the Mid State Communications model

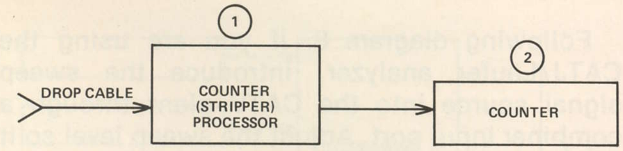

DIAGRAM 5

SP-2, you automatically have the inter-carrier signal brought out to drive a frequency counter (see diagram 5). Any measurement of the audio carrier of a TV signal requires a 10 second averaging, that is, because of the high modulation index present with the FM sound, the actual aural carrier frequency must be "averaged" by the counter over a sufficient length of time to insure that the average frequency measured, over a measurement cycle, is in fact the carrier frequency and not some instantaneous modulation index frequency. In any counter utilized, there must be a ten second (or longer) averaging time constant in the counter or it is not useful for aural carrier or inter-carrier (sound) frequency measurement.

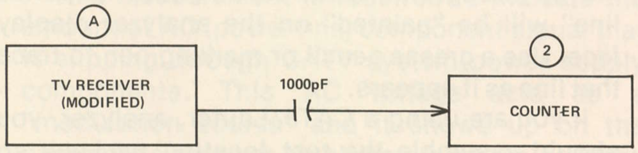

DIAGRAM 6

Another technique, which has been previously discussed, is shown in diagram 6. A standard television receiver is coupled to a relatively low cost low frequency counter (i.e. one capable of handling up to 4.5 MHz). A 1000 pF ceramic disc (coupling) capacitor taps into the receiver at the discriminator (sound ratio detector) and the signal it picks off there is utilized to drive the low frequency (or other) frequency counter. Again, the counter needs to have at least ten second averaging to properly display the actual aural (inter) carrier frequency.

Note: This measurement required only on cable channels re-modulated at the system, and only for Class I (i.e. broadcast) signals.

The CATJ/Laufer Analyzer As A Measurement Tool

One year ago, the CATJ/Laufer low cost analyzer was more of a curiousity than a serious measurement tool. Following the originally published paper by Jerry Laufer in the **July 1975 CATJ,** a few dozen of these units were constructed by CATV operators across the country. However, during 1976 **CATJ** offered a "kit building course" at this past summer's CCOS-76 meeting, and there 25 CATV system people constructed this kit and took these low cost analyzers home with them to put them to work. Subsequently in our **September** (1976) **CATJ** we re-visited the low cost analyzer and offered complete parts kits to readers. 80 such kits were ordered and shipped to system people from Ontario to south Texas, Maine to Oregon. With approximately 130-150 such kits now in CATV system hands, the "day of the low cost analyzer" is here and consequently several test sequences built around the convenience of this instrument have been devised. Additionally, the low cost analyzer is now a standard part of the "CATA Test Equipment Package" (see page 37 here this month).

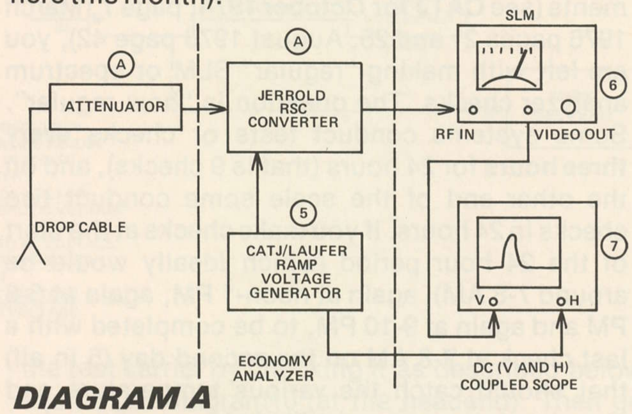

DIAGRAM A

Reference is made to diagram "A". For those who are not familiar with the unit, a varactor tuning head from a Jerrold RSC series set top converter is made to "sweep" through the TV channels of interest (any **single** VHF channel **up to** the full range of the RSC converter unit) by an outboard "ramp generator". The output of the ramp-tuned converter head is received at the i.f. output channel of the RSC converter on a standard signal level meter, which must have a video output (i.e. detector output). That video (detected) output is in turn used to drive the vertical input circuit for a DC coupled scope. That vertical drive to the scope forms the "blips" or "signal present" lines on the scope display screen. Horizontal (sync) drive for the scope comes from the ramp generator.

Visual Signal Level Stability — 76.605 (a) (5)

The rules require that within a 24 hour measurement period that any Class I (i.e. broadcast) signals carried on the cable shall stay **stable** at test locations, within a 12 dB "window".

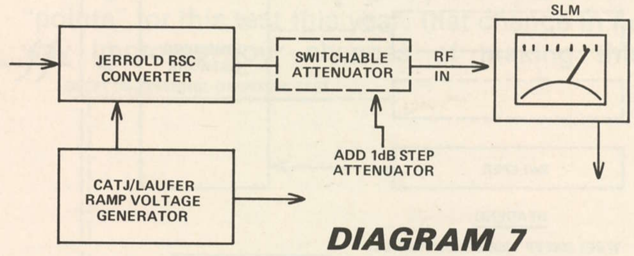

DIAGRAM 7

By utilizing the low cost economy analyzer, all visual carrier signals carried by the system are simultaneously displayed. Using a grease pencil or felt tipped pen, the actual carrier levels present are "marked" on the scope screen. Then by inserting a 12 dB pad (see diagram 7) the levels at that moment are dropped by 12 dB and another set of levels are shown and marked on the scope screen. This becomes the "window" for the measurements. If 6 dB is now removed from the pad (diagram 7), the signal levels will return to a point 50% between the two sets of marks.

The FCC does not specify **how** you are to determine that your signals stay within a 12 dB window within a 24 hour period, and lacking the equipment to perform chart recorded measurements (see **CATJ for October 1974,** page 7, March 1976 pages 21 and 25, August 1976 page 42), you are left with making "regular" SLM or spectrum analyzer checks. The question is "how regular". Some systems conduct tests or checks **every three hours** for 24 hours (that is 9 checks), and on the other end of the scale some conduct two checks in 24 hours. If you make checks at the start of the 24 hour period (which ideally would be around 7-8 AM), again at noon-1 PM, again at 5-6 PM and again at 9-10 PM, to be completed with a last check at 7-8 AM on the second day (5 in all) that should catch the various temperature and signal extremes you are likely to experience in a **typical** day.

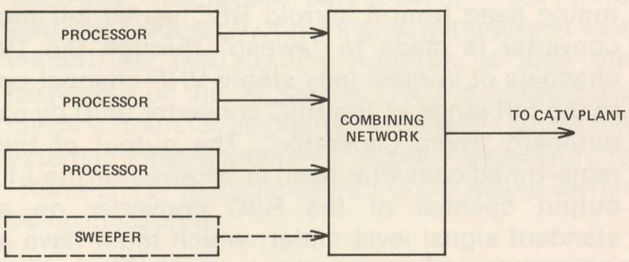

DIAGRAM 8

Another way to check the system plant for "stability" is to not fool around with the TV carriers themselves, but rather to introduce at the headend a "sweep signal" as shown in diagram 8. The sweep signal is sent throughout the full plant, and it can be read on a spectrum analyzer (including the low cost economy analyzer if certain precautions are taken), or even a signal level meter.

Following diagram 8, if you are using the CATJ/Laufer analyzer, introduce the sweep signal source into the CATV plant through a combiner input port. Adjust the sweep level so it is approximately 10 dB below the lowest TV carrier level at this point (if you are using another analyzer such as a VSM-5, Kay P9040, etc. keep your sweep level 30 dB below the lowest headend TV carrier level). Adjust the sweep width and tuning range to sweep from 50-220 MHz (for a 12 channel system), or to coincide with the bandwidth of your TV distribution plant. Adjust the sweep rate to sweep through the frequency range chosen in about 10-12 seconds time, and place the sweep into the "triggered" mode.

With the analyzer at a test location, set the analyzer system (CATJ/Laufer or other) to cover the bandwidth of the headend sweeper. If using a spectrum analyzer other than the CATJ/Laufer, set for a repetition rate of 30-60 Hz. Now trigger the sweep at the headend and as the sweep signal moves through the spectrum a "sweep response line" will be "painted" on the analyzer display face. Use a grease pencil or marking pen to trace that line as it appears.

If you are using a CATJ/Laufer, analyzer, you should assemble the test location package so that you have a 1 dB step attenuator inserted between the output of the RSC converter head (i.e. at the i.f. **output** channel connector of the converter head) and the input of the signal level meter. Start with 10 dB of attenuation in this switchable pad, and when the test is repeated at each measurement period, add or subtract attenuation with the 1 dB pad to bring the "painted swept response line" back even to the first display. The amount of attenuation added or subtracted to bring each successive measurement "painted display" back in line with the first display drawn on the CRT face **is your amount of "deviation" from the first test.** Record that amount for your test log book (see diagram 9

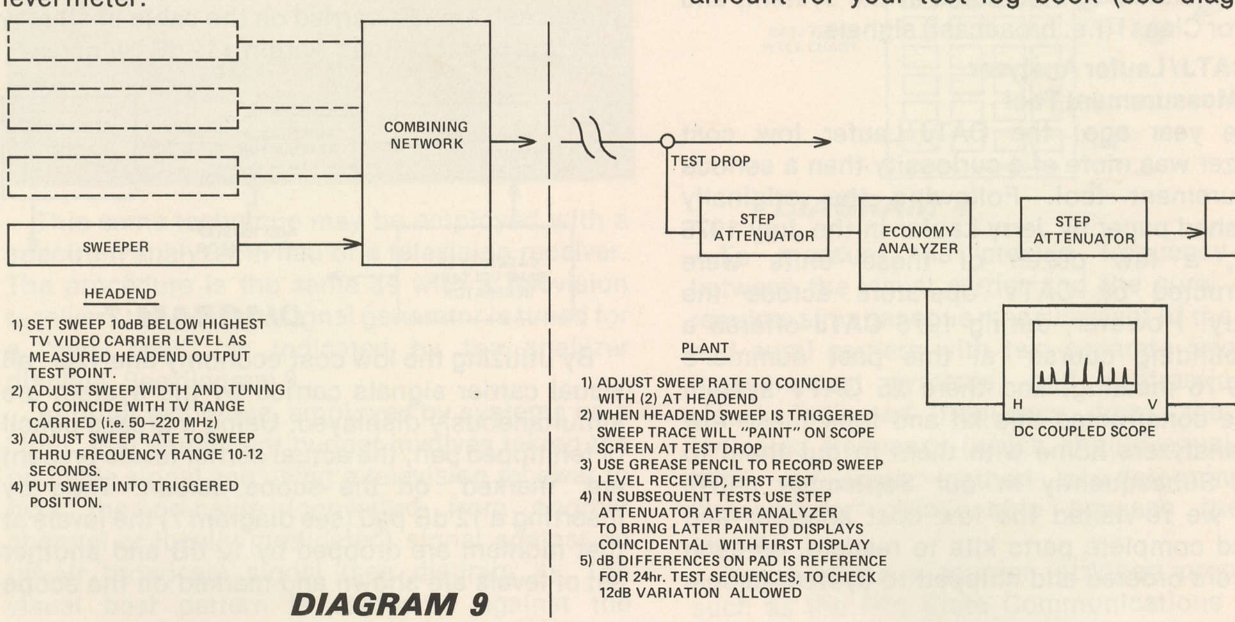

DIAGRAM 9

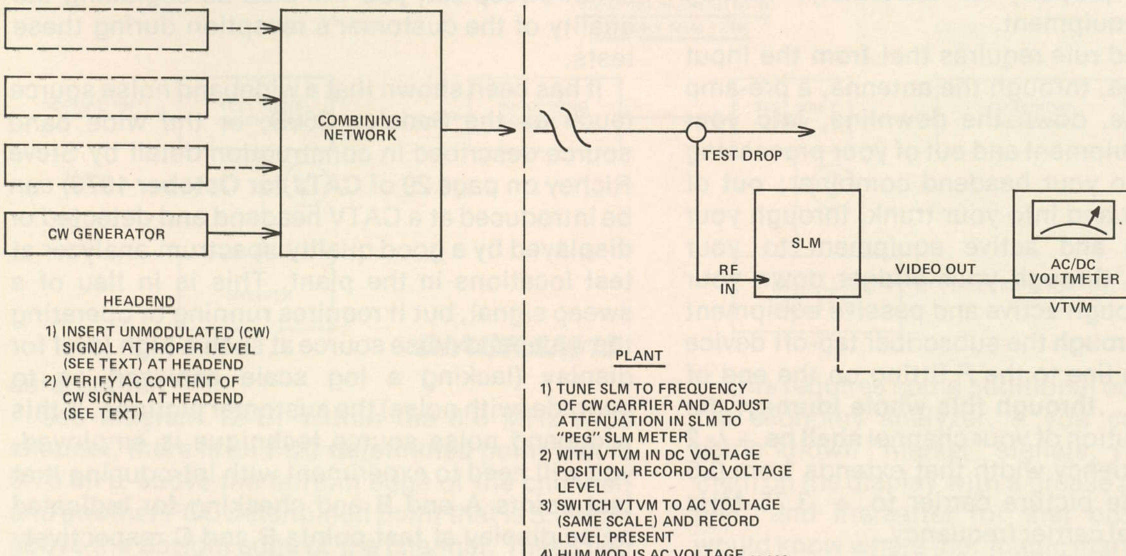

DIAGRAM 10

here).

Hum Modulation Measurement - 76.605 (a) (7)

This measurement is required to indicate the amount of AC (power line) component signal that is slipping through CATV system power supply components. This AC voltage acts as a "modulation source" and it shows up on the customer's receiver as alternating bars of black and white (called 'hum mod'). When it is very severe, the presence of this AC signal on the TV carrier causes the picture to distort (vertically) and the TV carrier sync to be masked (causing vertical roll of the picture). For a full discussion of this, see pages 20-25 **January 1976 CATJ.**

By inserting into the cable system an unmodulated carrier, **one known to be free** of any self contained hum modulation at the headend, you have a 'carrier' that should be free of any AC modulation when it is checked at any point within the cable plant. The only way a hum-free carrier can leave the headend and turn up **with hum mod** at a test location is for that carrier to be hum modulated along the way by the plant electronics (or passives!).

See diagram 10. Insert the test carrier at the headend (a pilot carrier, if not modulated, can be used). Verify the amount of hum mod built-into the test carrier by checking it as described below and as per diagram10 (at the headend). Then go into the plant and at a test location install a signal level meter that has a video (detector) output jack. Out of the video output jack on the SLM, run a cable to an AC/DC voltmeter (VTVM). With the VTVM in the DC voltage position, read the amount of DC voltage present. Without touching the SLM, switch to the AC voltage and read the amount of AC voltage present.

The hum mod present is equal to the AC voltage present divided by the DC voltage present, times 100. This will be a fraction, and to comply with FCC standards it shall be less than 5% (0.05).

An alternate technique utilizes an AC/DC coupled oscilloscope in lieu of the AC/DC VTVM, for a full description of this approach see pages 24-25, **January 1976 CATJ**, or the "CATJ 1977 FCC Tests Cookbook".

In Channel Frequency Response — 76.605 (a) (8)

Last year we said that this test was the most difficult test of all to perform accurately, unless you have access to simul-sweep equipment. And although the FCC has changed the measurement "points" for this test this year, that change in no way improves your chances of making this

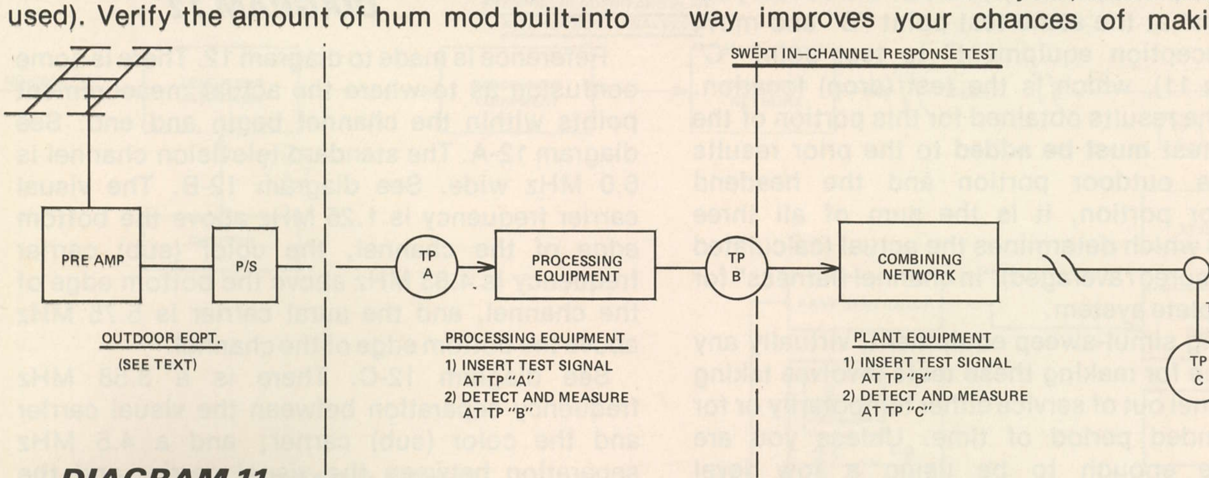

DIAGRAM 11

measurement properly or accurately, lacking simul-sweep equipment.

The modified rule requires that **from** the input to your antenna, through the antenna, a pre-amp if you use one, down the downline, **into** your processing equipment and out of your processing equipment into your headend combiner; **out** of your combiner and into your trunk, through your trunk passive and active equipment to your trunk/bridger, **through** your bridger down your feeder line through active and passive equipment to the drop; **through** the subscriber tap-off device down the drop line to the F fitting on the end of the drop line. . .**through this whole journey,** the **maximum** variation of your channel **shall be + /- 2 dB** over a frequency width that extends from 0.5 MHz **below** the picture carrier to + 3.75 MHz **above** the visual carrier frequency.

That is some trick.

Measuring it is even more of a trick.

For measurement purposes, we can separate the three segments of the signal path into primary components as follows:

(1) **The outdoor equipment** (i.e. antenna, pre-amp, downline);

(2) **The headend processing equipment;**

(3) **The plant equipment.**

The FCC allows you to take manufacturer's data sheets for the **outdoor** equipment (see diagram 11) and to "sum" the total influence of each component. Your antenna data sheet **may** have a 1 dB tilt towards the audio carrier (for example), the pre-amplifier may have a 1 dB tilt downwards towards the video carrier frequency. In theory, one would balance the other out. The downline would in theory be flat.

For headend processing equipment, you can insert a test signal of one type or another at test point "A" as shown in diagram 11, and measure the extent of flatness over the required frequency width at test point "B" (diagram 11). Whatever type of flatness response you see here must be **added to** the net effect of the outdoor equipment, which you have calculated from the manufacturer's data sheets.

For the plant portion, you can introduce your test signal at the same test point "B" and move your "reception equipment" to test point "C" (diagram 11), which is the test (drop) location. Again, the results obtained for this portion of the system test **must be added** to the prior results with the outdoor portion and the headend processor portion, it is the sum of all three sections which determines the actual (calculated and measured/averaged) "in channel flatness" for the complete system.

Lacking simul-sweep equipment, virtually any technique for making these tests involves taking the channel out of service either temporarily or for an extended period of time. Unless you are fortunate enough to be using a low level simul-sweep set, you will also be degrading the quality of the customer's reception during these tests.

It has been shown that a wideband noise source (such as the Sadelco 260B, or the wide band source described in construction detail by Steve Richey on page 29 of **CATJ for October 1976**) can be introduced at a CATV headend and detected or displayed by a good quality spectrum analyzer at test locations in the plant. This is in lieu of a sweep signal, but it requires running or operating the wideband noise source at such a high level for display (lacking a log scale analyzer) as to degrade (with noise) the customer pictures. If this wideband noise source technique is employed, you will need to experiment with introducing it at test points A and B and checking for indicated noise display at test points B and C respectively to determine the **lowest** level you can run this wideband noise through the plant, obtain an adequate analyzer display, **and still keep customer dis-satisfaction** at a minimum for the testing period.

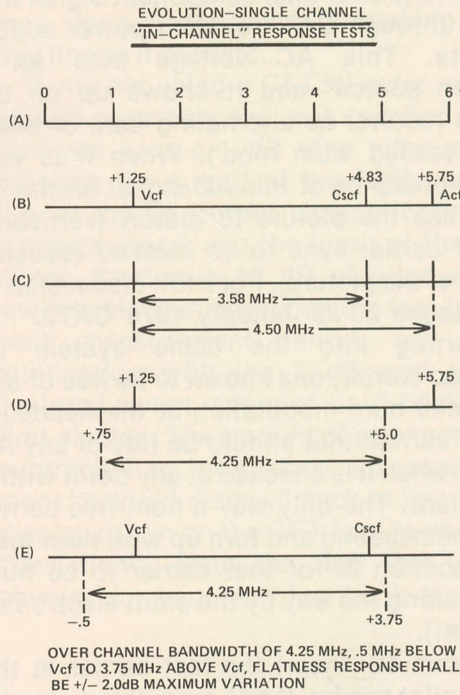

DIAGRAM 12

Reference is made to diagram 12. There is some confusion as to where the actual measurement points within the channel begin and end. See diagram 12-A. The standard television channel is 6.0 MHz wide. See diagram 12-B. The visual carrier frequency is 1.25 MHz above the bottom edge of the channel, the color (sub) carrier frequency is 4.83 MHz above the bottom edge of the channel, and the aural carrier is 5.75 MHz above the bottom edge of the channel.

See diagram 12-C. There is a 3.58 MHz frequency separation between the visual carrier and the color (sub) carrier; and a 4.5 MHz separation between the visual carrier and the

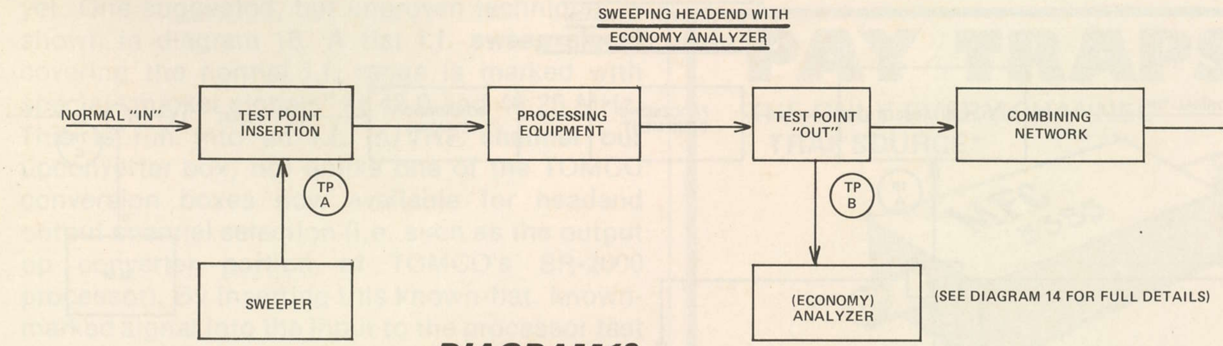

DIAGRAM 13

aural carrier.

See diagram 12-D. **Within** the 6.0 MHz wide channel, there is an **FCC determined point** that is 0.75 MHz **above** the bottom edge of the channel, and **another** FCC determined point that is 5.0 MHz **above** the bottom edge of the channel. These two FCC determined points create a "window" inside of which there is 4.25 MHz of spectrum space. **This is the "window"** within which you must keep your system response, from antenna input to customer drop, **flat to within + / - 2.0 dB.**

See diagram 12-E. This "window" **begins** at a point **0.5 MHz below** the visual carrier frequency and extends to a point **3.75 MHz above** the visual carrier frequency.

Various techniques for making this measurement, using signal generator carrier sources, have been previously described in considerable detail (see pages 28-31 **January 1976 CATJ**, and "CATJ 1977 FCC Tests Cookbook"). We will describe an alternate approach utilizing a sweep signal generator and the CATJ / Laufer analyzer.

In diagram 13 a sweep signal is introduced into the headend processing portion of the plant via a directional tap or other suitable isolation device. The economy analyzer is connected to test point B, which is the input test point on the channel combiner, or the end of the inter-connecting line that terminates the processing equipment in the combiner (or input to DT used as portion of combining system). So far so good. The only problem is **how do you know** where the magic + 0.75 and + 5.0 MHz points are?

This requires some additional equipment. With the economy analyzer, if you could introduce some known "marker" signals, you could mark them on the display with a grease pencil / marking pen; and thereafter **for that one channel** you would know where the "magic marks" are located. We'll assume you have done this, with a signal generator and a counter, prior to starting with the sweep. Then introduce the sweep into the appropriate input test point. Set the sweep **width** to approximately 2 MHz above and below the full 6 MHz channel (i.e. 10 MHz wide). Trigger the sweep at a sweep rate of 12-15 seconds. A picture will be "painted" on the analyzer (scope) screen. Repeat the sweep triggering two more times, raising and lowering the sweep source by 2 dB each time. As each sequence is painted on the screen, take a grease pencil and draw the display on the CRT screen.

To repeat the test for the plant itself, use the same sequence substituting test point "B" as the triggered sweep input and test point "C" as the receiving location (i.e. test drop location). Insert, per diagram 14, a step attenuator ahead of the economy analyzer package and trigger the sweep three times, once with 0 dB attenuation in the line, once with 2 dB attenuation and once with 4 dB attenuation. Draw each display on the CRT, thereby creating the "window" for the display flatness check. Or, alternately, if the sweep has a calibrated output level control or you have an external pad with 1 dB steps at the headend and after the sweep, do the "window" set of three

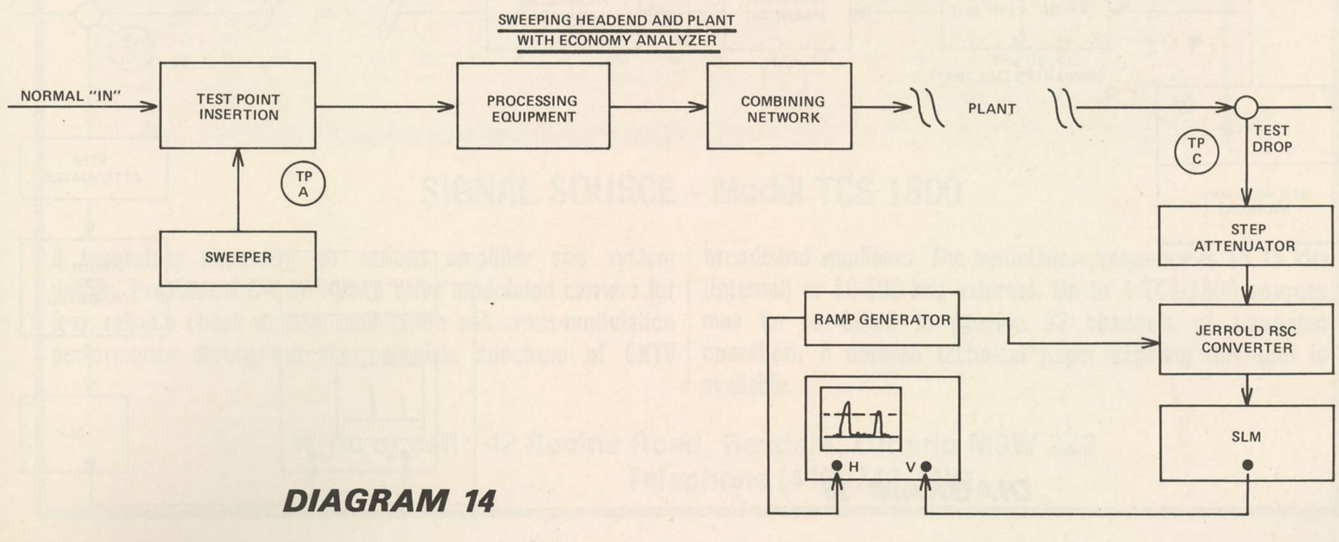

DIAGRAM 14

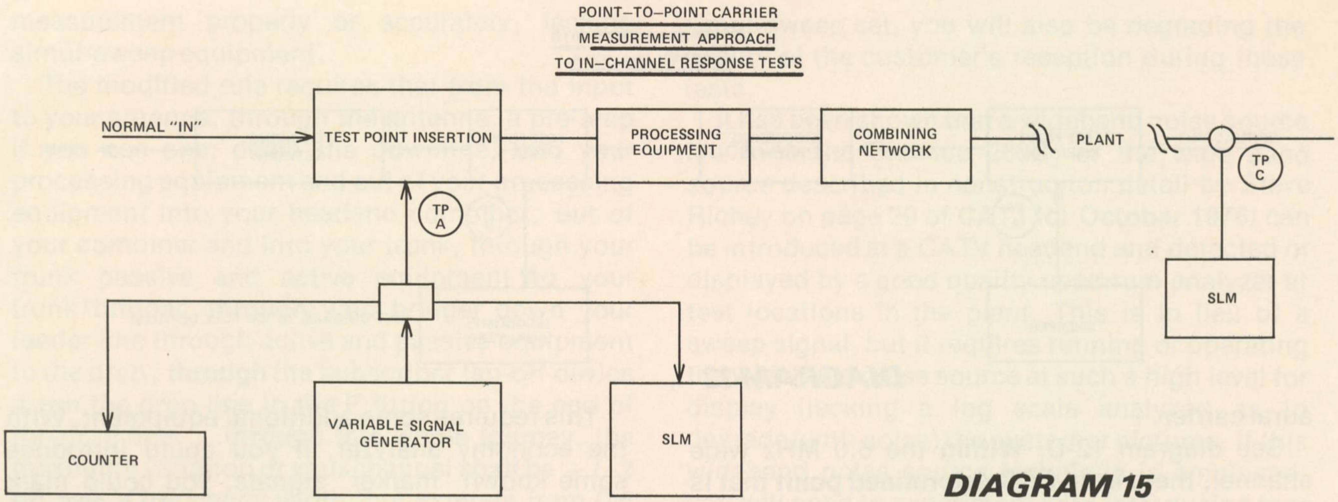

DIAGRAM 15

triggered sweep originations at that point. This "window dressing" is necessary with the economy analyzer because the economy display system does not have the nicely calibrated display screen found with other analyzer packages (i.e. such as '2 dB per vertical division').

See diagram 15. The alternate approach, covered in great detail on pages 28-31 of **CATJ for January 1976**, requires the use of (1) a signal generator, (2) a signal level meter, (3) a frequency counter. . .**at the test input port;** and, at the "receiving end" (i.e. the test point drop), a signal level meter. This **seemed** like a difficult way to go last year, it is **not** that much better this year, primarily because it requires that you operate the signal generator at the same level as the real TV carriers (which can be left on the system, although herringbone patterns will appear as long as you are near the visual carrier frequency with the signal generator). The signal generator is first adjusted to a point (as read out by the counter) 0.5 MHz **below** the visual carrier frequency. That level is read by the SLM at the test drop. Then it is wheeled up to the visual carrier frequency and the measurement repeated (this can be tough with the TV signal still present, **you may have to drop it momentarily**). Next wheel it upwards to 2 MHz above the visual carrier and measure the level with the SLM. Finally, go up to a point 3.75 MHz above the visual carrier frequency and repeat. Record all measured levels at the test point drop (the SLM **at the headend** is in place to insure that the level at the origination point, in the headend remains constant; it would not do to have your signal 'source' varying in level while making this measurement at the test point drop.).

When we reach this point, it becomes more and more evident that the in-channel response tests are no better off than they were last year. Using the triggered sweep and economy analyzer is perhaps slightly easier on the customers than signal generator approach, but it is not much better on the test technicians. Wideband noise is in about the same boat. All systems require two people, one at the headend and one at the test location, and communication between the two of some sort. With three test locations involved, there is a fair amount of set up, test and knock down time per location.

There may be help on the way, but it is not here

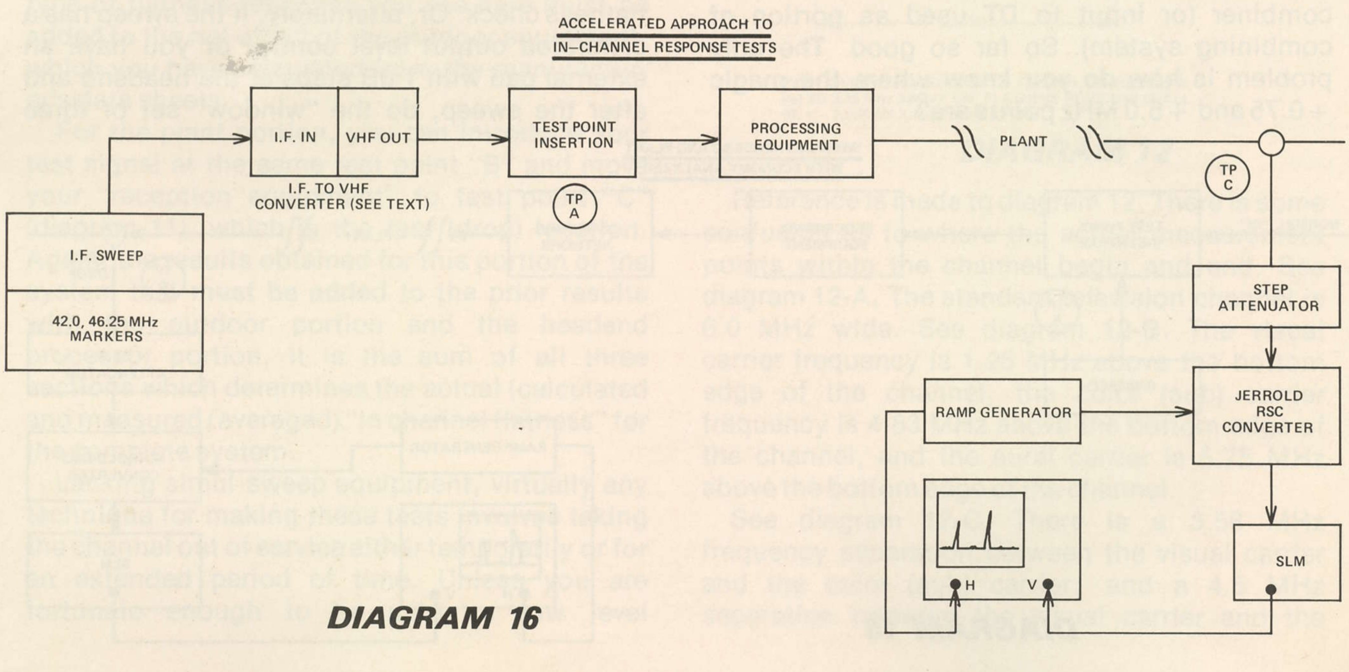

DIAGRAM 16

yet. One suggested, but unproven technique, is shown in diagram 16. A flat **i.f. sweep signal** covering the normal i.f. range is marked with special "marker signals" at 42.0 and 46.25 MHz. This is run into an **i.f. in/VHF channel out** upconverter box, not unlike one of the TOMCO conversion boxes now available for headend output channel selection (i.e. such as the output up converter **portion of** TOMCO's SR-2000 processor). By inserting this known-flat, known-marked signal into the input to the processor test point port ahead of the processor, an analyzer (such as the economy analyzer) at the test point location would see the sweep signal (triggered or constant) plus the markers. By switching the output channel to the cable channels to be measured, you have a method of switching quickly from channel to channel, with the markers intact.

Such an instrument does **not** now exist; but it could, with some not terribly clever packaging of existing modules commonly available in the industry. Hopefully before the FCC gets up a head of steam on enforcing this still impossible to make test (impossible at least for most systems), someone within the industry will come up with a solution. Or, better yet, the FCC will recognize that inspite of best intentions, there is still no real demonstrated need for this particular test.

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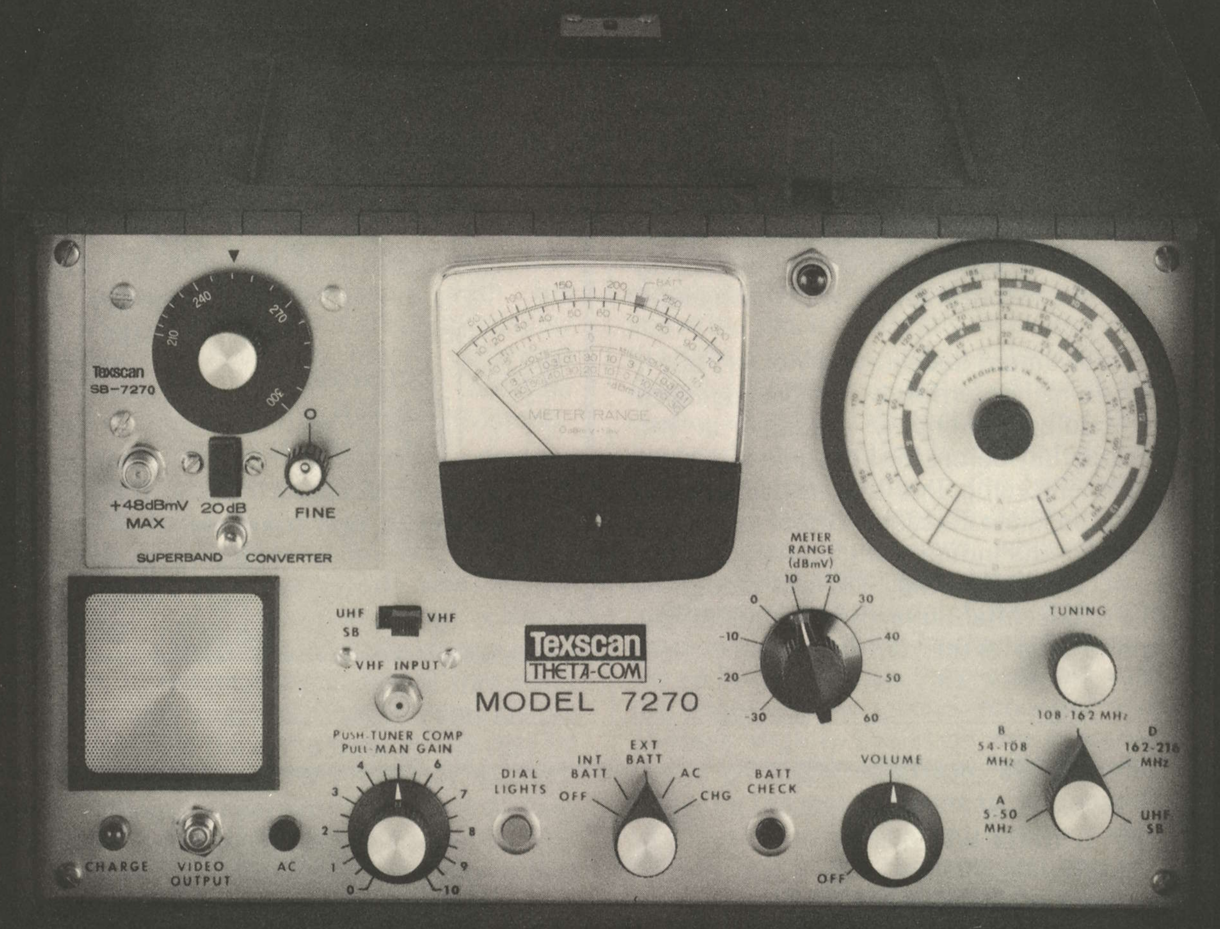

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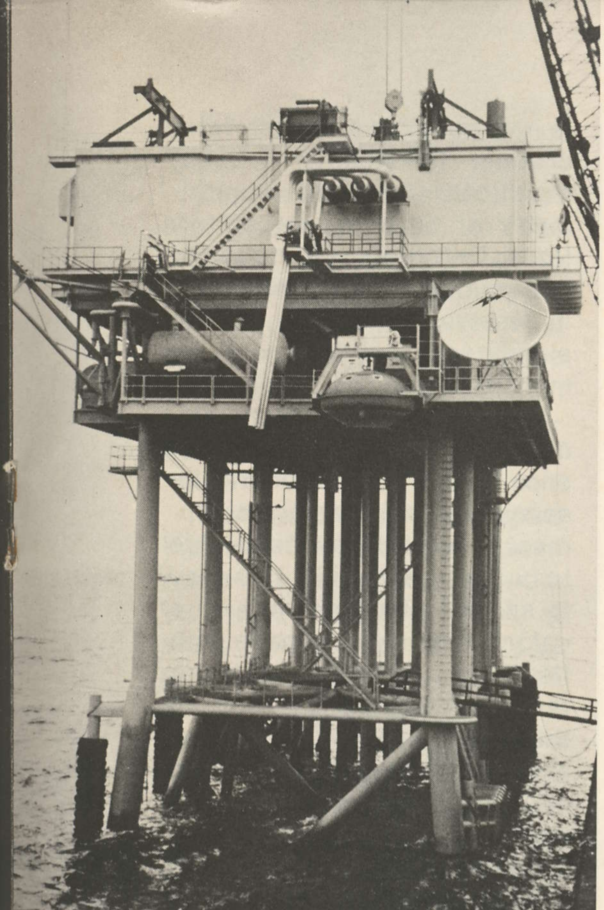

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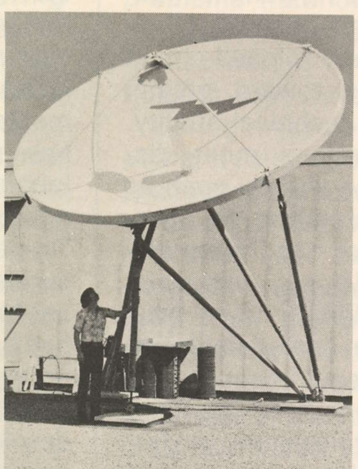


Building Rooftop

A NEW APPROACH TO SIGNAL TO NOISE MEASUREMENTS

(Try This On For Size)

The November 1976 issue of CATJ contained a lengthy report on analyzer techniques, and the specific problems which arise when a CATV system engineer attempts to measure signal to noise ratios with even the most sophisticated analyzer instruments available in the industry today.

The bottom line is that because of the large amount of video information present with the RF waveform, it is almost impossible to make meaningful signal to noise measurements, unless the television station cooperates in the exercise by employing a form of square wave modulation. Or, if the off-air signal has a large amount of random or manmade noise married to the RF signal present, you can determine the signal to noise ratio; but by the time you reach such a measurement plateau, your signal to noise ratio is typically under 40 dB.

It may be, as we learned in November, that without the cooperation of the broadcast station (something that is not feasible when you have a large number of channels to measure and the television stations simultaneously have a large number of cable systems utilizing their signal) such measurements are beyond the capacity of today's analyzer instruments.

As often happens in a situation like this, someone comes along with a totally different approach to signal to noise ratio measurements. The following paper was prepared by Richard N. Lawrence of Lenco, Inc. (Electronics Division), Jackson, Missouri; and was presented to the Central Canada Broadcaster's Association Engineering Section Convention this past October.

Basically appearing as his paper was originally written, Mr. Lawrence suggests that his firm has developed a "magic box" which may solve signal to noise measurement ills for CATV systems. The unit described has applications far beyond normal CATV; one of the prime suppliers of earth receiving terminals for cable is currently evaluating this unit as a possible addition to their present down converter/receiver system.

CATJ will be receiving one of the Lenco VNM-42B units sometime during January; and in our Lab we will run the unit through its paces and report back to you later this spring on how it works. We have also been told that at least two prominent state agencies with PUC type regulation for cable are currently starting to add the VNM-42B unit to their mobile test vans for cable systems. And well they might, for as Mr. Lawrence points out, the average set up time to make a signal to noise test is around ten seconds time; and the resulting accuracy is within +/- 0.5 dB.

by
Richard N. Lawrence
Lenco, Inc. (Electronics Division)
Jackson, Missouri

The continuing trend in modern television broadcasting, cable TV, and closed-circuit operations is toward greater emphasis on technical quality. Signal distortions most disturbing to the viewer, such as hue shift, saturation changes, group delay or quadrature distortion, and now incidental phase problems have been subjected to considerable attention by equipment manufacturers, standards committees, and television professional societies. As a result, it is now possible to switch from channel to channel without significant variations in colorimetry or other viewer distortions. The only area that has not been subjected to the attention it deserves, until now, is the simple and accurate measurement of noise.

Random noise is a more insidious form of signal interference which characteristically accumulates in aging equipment or appears suddenly due to faulty components. It is easy to see 10° of phase shift on a color bar pattern or image with flesh tones, even though it represents only a 3% error. I think it is safe to say that almost every television station or facility has at least one vectorscope that can be used to measure it. It is much more difficult to subjectively assess the difference **between** 40 dB and 46 dB of signal to noise ratio, **notwithstanding the fact that this is a proportionally much larger defect.** Yet, very few broadcasters, **cable companies,** microwave users, or industrial system houses have equipped themselves to accurately measure noise. Why is this? It is because, until now, the accurate measurement of video signal-to-noise ratios require expensive, non-portable equipment, that usually requires the **insertion of test signals** at one end of the system, **which requires the system to be taken out of service,** and/or requires many mathematical calculations to determine the true value of the noise ratio. Noise measurements of television equipment has now come out of the laboratory and entered the operations field as a standard "in-service" technique for accurately assessing this important facet of signal quality. This has happened because, as this paper will discuss, new and simpler equipment has been developed specifically for this purpose.

PRESENT METHODS

There are three methods that are presently used in the television industry, TV noise meter, visual noise comparison, and in some cases, the spectrum analyzer. All of these techniques are now used in broadcasting/cable but are limited to only certain applications.

The most widely accepted instrument for measurement of noise in labs and network technical centers is made in West Germany by the Rohde and Schwarz Company. This noise meter is both reliable and precise but is **not** very portable and is **not** designed for in-service measurements. As a laboratory instrument mounted in a 19" rack and used for flat grey field tests, it has no equal and remains the device most used to calibrate other instruments. However, television studios, **cable systems,** and industrial users need noise measuring instruments that better suit their particular requirements for portability, ease of operation, accuracy, and most important, cost.

Other recent entries into this field have been the Tektronix Visual comparison techniques. Tektronix has published adequate information about the use of these products, and they certainly come closer than the Rohde and Schwarz meter to the needs of the general television industry engineering groups who operate and maintain equipment. However, they require a special line-selection oscilloscope as an accessory, cannot measure in the presence of chroma, are designed for rack mounting, and specify an accuracy of only +/-2 dB.

The spectrum analyzer technique is designed basically for RF Carrier-to-Noise measurements, and is not applicable to this paper except when carrier-to-noise measurements are specifically required.

THE NEW APPROACH

A new device has been introduced which utilizes a different principle of operation than any other instrument now in use. The Lenco Model VNM-428 Video Noise Meter was designed specifically for the Video signal-to-noise measurement requirements of TV studios, microwave systems, **cable television** and industrial system users where portability, simplicity of operation and accurate measurements are desired at a relatively low cost.

One of the major features of the device is the in-service capability of making accurate, real time signal-to-noise measurements **even on live off the air signals.** The noise meter is small, rugged, stable, and has a built in calibrator that insures accuracy of +/- 0.5 dB throughout the range of 20 dB to 55 dB. The signal-to-noise ratio is shown directly on a large LED display and calibrated to FCC/EIA standards. What's more, **this is done with any normal oscilloscope** having a **bandwidth of 5 MHz or more** with any **composite video signal** with an input level from .5 V p-p to 1.5 V p-p.

DESCRIPTION OF MEASUREMENT PROCESS

The Lenco Model VNM-428 Video Noise Meter employs the tangential noise measurement technique to circumvent the problems traditionally associated with the oscilloscopic measurement of Gaussian noise in video waveforms.

During measurement, a variable and calibrated **square wave** is added to the waveform under test which results in the display appearing as two identical waveforms, **one displaced vertically from the other** by the distance **equal to the amplitude of the square wave.** When the amplitude of the square wave is large compared to the noise, **corresponding portions of the two traces are separated by a dark interval.** As the amplitude of the square wave is **reduced,** the width of the dark band **decreases** and finally disappears. At the point where the dark band just disappears, leaving a single trace with uniform brightness in its central region, **the square wave amplitude is equal to twice the RMS noise voltage of the signal.** The amplitude of the square wave is measured by the Noise Meter, converted to a logarithmic scale, referenced to the peak-to-peak signal, **and displayed** on the digital panel meter **as the ratio of signal-to-noise in decibels.** The meter can be calibrated to read directly in either the EIA or CCIR System M standards. Normal factory calibration is in

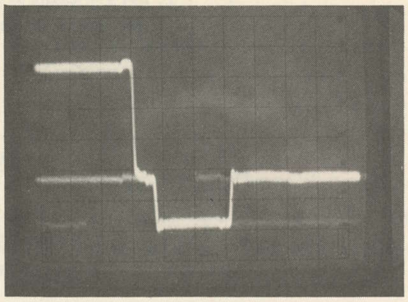


Figure 1-A Typical video waveform with SNR = approximately 39 dB.

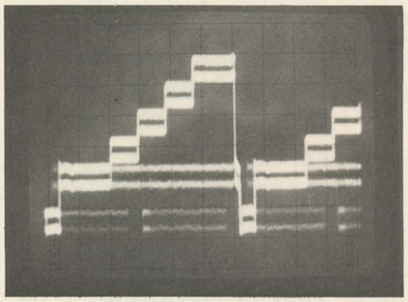


Figure 1-B Video waveform with added square wave greater than twice rms noise.

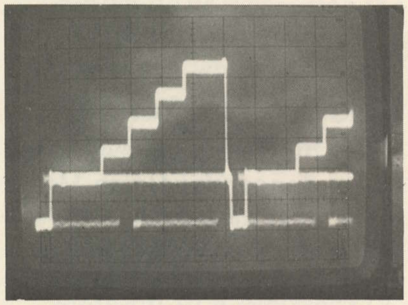


Figure 1-C Square wave amplitude just equal to twice rms noise.

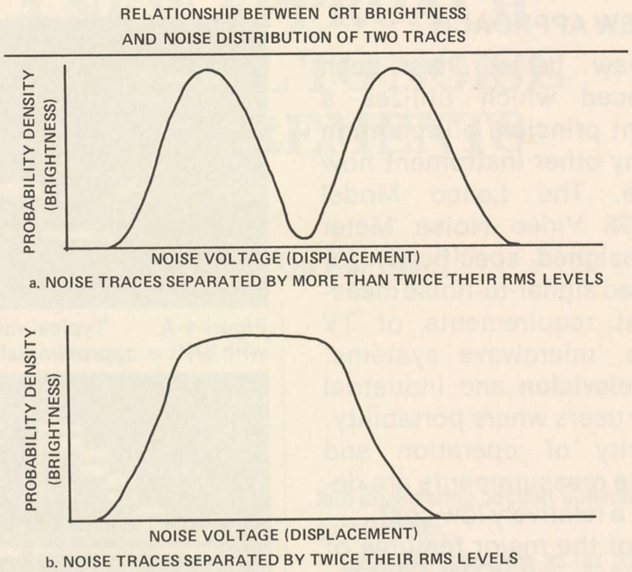


DIAGRAM 2

the EIA/FCC System M standards. **That is important**. . .under **normal** waveform conditions, **no mathematical calculations** or conversion factors are required.

THEORY OF OPERATION

The mathematical evaluation of the Tangential Noise Measuring method, including the relationship between trace separation and RMS noise is explained with the following:

If the probability distribution of amplitudes in random noise is Gaussian, then the distribution of brightness across the noise trace displayed on an oscilloscope will also, to a very good approximation, be Gaussian. This relationship may be seen in the graphs of Figure 2 in which the axis are labeled interchangeably in terms of trace brightness and probability density. If two identical oscilloscope noise traces are separated by more than twice their RMS voltage, the result will be as shown in the graph of Figure 2-A. The dip between the two peaks corresponds to the narrow dark band seen between the bright bands of the two separated traces. When the trace centers are separated by a voltage equal to exactly twice the RMS noise voltage of each, the dip (dark band) disappears as shown in Figure 2-B.

FUNCTIONAL OPERATION

A functional block diagram of the VNM-428 Video Noise Meter is shown in Figure 3. Power is supplied to the instrument through a signal primary transformer, rectifier and filter system. The output of this primary supply is at approximately +/- 18 volts. Proper operating voltages are supplied to the various sections of the instrument by a tracking +/- 12 volt regulator and three + 5 volt regulators.

Oscilloscope trigger pulses are generated from composite and vertical sync waveforms that have been **separated from** the signal being measured. In the LINE SELECT mode, a delayed trigger pulse is generated which permits **oscilloscope display of selected video scanning lines.** This same trigger pulse is also used in the FIELD operating mode of the meter.

The separated sync waveform also triggers a flip-flop which generates the square wave used in measurement. In the LINE SELECT mode, the flip-flop is switched once each field, and in the LINE operating mode it is switched once each line. In the FIELD trigger mode, the flip-flop is driven from a free-running multivibrator oscillating at a frequency of approximately 280 KHz. Square waves from this flip-flop are amplified and added to the output of the video amplifier to form the signal displayed for measurement. The amount of square wave added is controlled by the MEASURE control. The DC component of the added square wave is obtained by low pass filtering with subsequent application to a logarithmic converter, the output of which controls the frequency of a multivibrator. This multivibrator drives counters in the integrated circuit

VNM–428 VIDEO NOISE METER FUNCTIONAL BLOCK DIAGRAM

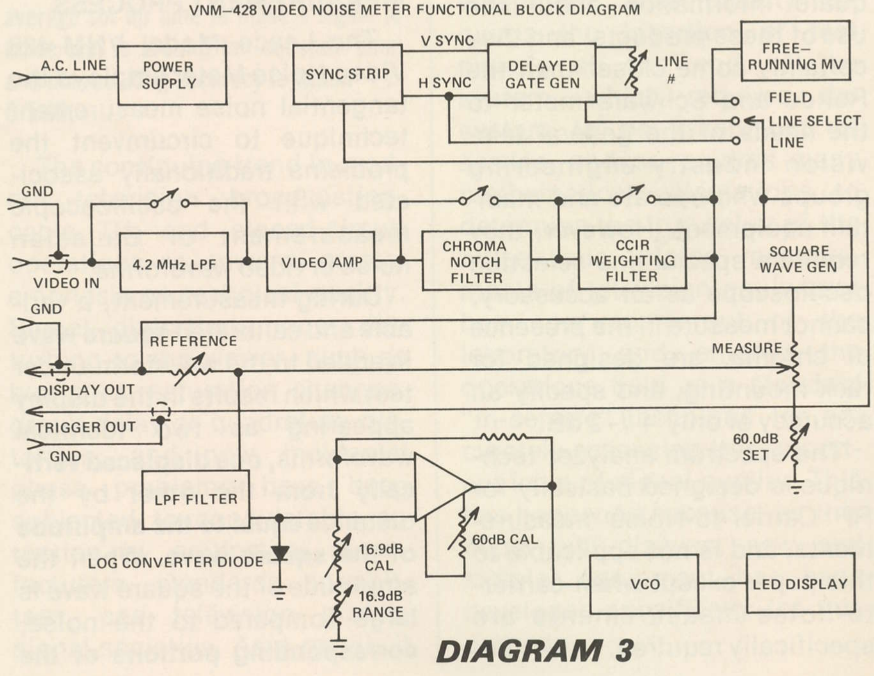


DIAGRAM 3

which drives the digital panel meter LED displays. A timer resets the counters to zero at the beginning of each period and, 0.1 second later, transfers the contents of the counters to latches which control the displays. This cycle repeats once each 0.5 second, continuously displaying the amplitude of the added square wave, and therefore, the Signal-to-Noise, in dB.

FILTER CORRECTION OF COHERENT DISTORTIONS

The VNM-428 is designed **to measure random noise on any composite video** waveform. Because other distortions that could effect accurate signal-to-noise measurements may be present in the waveform three modes of operation are offered. **If line-rate disturbances** such as tilt or ringing exceed approximately 50% of the peak-to-peak noise voltage, the measurement must be made in the LINE or LINE SELECT Mode. Otherwise, line-rate disturbances could cause a misleading thickening of the waveform in the field rate display. This also holds true if serious **field-rate disturbances** such as **hum** or vertical tilt are present, again a misleading thickening of the waveform in a line-rate display can occur. In this case the FIELD or LINE SELECT mode should be used. If **both** line **and** field-rate disturbances are present, accurate signal-to-noise readings will be achieved in the LINE SELECT operating mode.

Because discrete interfering signals such as intermodulation products, chrominance subcarriers, **and co-channel RF interference** can effect the **accuracy** of a noise measurement, the noise meter has three built-in **switchable filters.** They are: a 4.2 MHz Low Pass Filter, a Chroma Notch Filter and, for transmission noise measurements, a Noise Weighting Filter. Because of the many applications for **"in-service"** noise measurements and because discrete interference may **mask** random noise on the oscilloscope display, these highly precision filters play an important role in the overall instrument concept. For instance, if the interference is residual chrominance subcarrier, its effect can be eliminated by switching in the CHROMA notch filter. If the frequency of the interference is higher than 4.2 MHz, its effect can be reduced or eliminated with the low-pass filter. It might be well to note here that any **discrete** interference having a frequency greater than about 500 Hz, less than 4.2 MHz, and outside the band of the chroma notch filter must be separately reduced so that its peak-to-peak amplitude is less than the apparent noise peaks by at least a factor of ten to avoid contaminating the SNR measurement.

The noise weighting filter attenuates high frequency noise in accordance with CCIR Rec. 421-2. This gives added "weight" to low frequency noise, reflecting its greater visibility in a television picture. **Many experiments have shown that a given amount of low-frequency noise causes a greater loss in picture quality than does an equal amount of high-frequency noise.** Use of the weighting filter permits expressing the signal-to-noise ratio as a single number which is more closely related to picture quality than would be a simple power ratio.

The following general principles should be followed in selecting filters for a measurement:

1. If the measurement is being made in accordance with a particular standard such as EIA RS-250, select the filters appropriate to that standard.
2. Use the 4.2 MHz low-pass filter except when a broader noise bandwidth is specifically desired.
3. Use the chroma notch filter when measuring an encoded color signal. An example would be measuring the signal to noise ratio of a camera, where residual chroma in the picture could destroy the measurement accuracy.
4. Use the weighting filter only when noise weighting is specifically required to conform to a standard or, lacking a standard, when an indicator of subjective picture impairment is more useful than the actual ratio of signal to noise.

STANDARD	SIGNAL	RF NOISE BANDWIDTH	VIDEO NOISE BANDWIDTH	WHITE NOISE WEIGHTING FACTOR
EIA*	SYNC TIP TO PEAK WHITE	—	4.2 MHz	4.0 dB
CCIR	BLANKING TO PEAK WHITE	—	4.2 MHz*	6.1 dB*
NCTA*	**RMS CARRIER DURING PEAK SYNC**	**4.0 MHz†**	**NOT DEFINED**	**NONE**
TASO*	RMS CARRIER DURING PEAK SYNC	6.0 MHz	NOT DEFINED	NONE
CTAC*	RMS CARRIER DURING PEAK SYNC	3.33	NOT DEFINED	NONE

* FOR TELEVISION STANDARD SYSTEM M AS USED IN THE UNITED STATES.

† MEASUREMENT MAY BE MADE WITH BANDWIDTH OTHER THAN 4 MHz AND RESULT ADJUSTED MATHEMATICALLY.

FIGURE 4
RELATIONSHIPS AMONG SNR STANDARDS

In any measurement, the following general procedure should be followed:

1. Determine which portions of the waveform contain all noise generated within the system under test, and as little noise as possible generated outside that system.
2. Determine which portions of the waveform are least disturbed by ringing, tilt, hum and other coherent disturbances.
3. Select measurement mode and filters based on the above factors.
4. If in doubt, measure using all three available modes. The most accurate result is the one showing the highest signal-to-noise ratio since this mode will have been the least affected by non-random disturbances.

STANDARDS AND CONVERSION FACTORS

Numerous techniques and standards have been established for the measurement of signal-to-noise ratio in video and television systems. The most widely used are those of the CCIR (Comite Consultatif International des Radiocommunications), EIA (Electronic Industries Association), TASO (Television Allocations Study Organization), and CTAC (Cable Television Advisory Committee, US-FCC). The CCIR and EIA standards relate to baseband video while the TASO, and CTAC standards relate to radio frequency signals. The differences among standards in each category result from different definitions of signal amplitude, noise bandwidth, and noise weighting characteristics as shown in Figure 4 for television standard M as used in the United States and Canada. Translation among standards within each class is largely a matter of accommodating different definitions. The VNM-428 is normally calibrated to measure video signal-to-noise **according to the EIA standard definition,** with automatic appropriate modification when the CCIR noise-weighting or Chroma Notch filter are used.

The only conversion factor required using the VNM-428 would be when the instrument is used **in conjunction with a demodulator** to measure **carrier-to-noise ratios of a cable system** or transmitter output. In order to relate post-detection signal-to-noise ratio to pre-detection carrier-to-noise ratio, the **effective noise bandwidth of the demodulator must be determined.** Most television **demodulators** of reasonable quality **will have a noise bandwidth of approximately 3.5 MHz.** Because the VNM-428 reads signal-to-noise directly in the EIA standards, converting signal-to-noise carrier-to-noise per the FCC/NCTA standard is

$$CNR_{FCC} = [SNR_{EIA} + 3.59] \text{ dB}$$

The error introduced by the assumption of a demodulator having a 3.5 MHz noise bandwidth is not likely to be greater than +/-0.3 dB.

There is another assumption used in this new technique that could require a conversion factor to be considered. The noise meter will accept any video input level from 0.5 Volts peak-to-peak to over 1.5 Volts peak-to-peak because the reference control calibrates the instrument to reference to a 1.0 Volt peak-to-peak signal. The technique described here **assumes that the sync to video ratio is correct.** If it is not correct, that is, if the signal to be measured has actually only 35 IRE units of sync, the conversion factor, F1, is as shown in Figure 5. In this example you would add a + 1.3 dB to the noise meter reading.

APPLICATIONS

Nearly all video waveforms encountered while using the VNM-428 will have **originated in** either a television camera or a test signal generator, and many will have been subjected to **downstream processing**. This usually takes the form of **regeneration** of the synchronizing and blanking pulses and color reference burst. **As a result, the picture portion will contain noise from all parts in the generation, recording, and transmission chain, while blanking and sync might only**

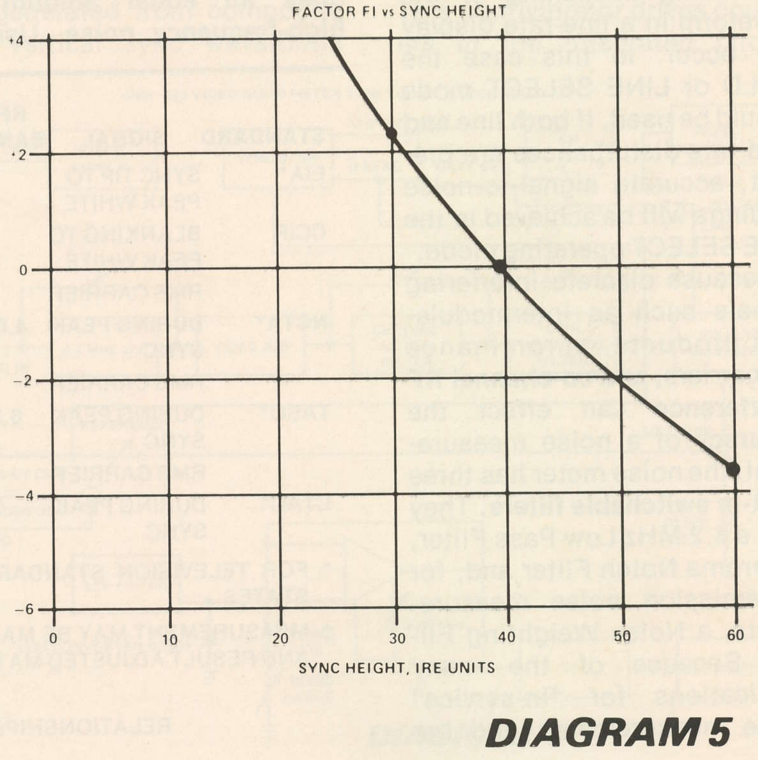


DIAGRAM 5

contain noise contributed by the last segment. Signals broadcast by stations of the major television networks may consist of as many as three or four identifiable portions, each regenerated or inserted at a different point in the chain, and each carrying a different mixture of noise representing the performance of a different part of the chain.

In many applications of the VNM-428, it will be desired to measure the signal-to-noise ratio of only one aspect of the generation and transmission process. For example, measurements made at a CATV subscriber drop will likely be designed to show the noise performance of the CATV off-air pickup and distribution plant while avoiding noise introduced by cameras, video tape recorders, and microwave systems that preceded broadcast of the signal. Since most television broadcast stations regenerate sync, blanking, and burst immediately prior to transmission, these portions of the waveform will be the most noise-free at the time of transmission, and will most accurately reflect the CATV system noise performance.

The VNM-428 can be used to measure the noise performance of all or part of a long-distance microwave transmission system. Measurements made at the system terminus can determine the performance of the overall system or of various sections of the system if appropriate lines in the vertical interval are blanked at specific locations. For example, assume it is desired to monitor a television microwave system originating in New York with baseband sections in Washington, D.C., Chicago, Denver and Los Angeles, and the terminus in Seattle. Programs are recorded, delayed and replayed in Los Angeles. If line 18 is blanked or otherwise reconstructed in Chicago, the noise seen on line 18 in Seattle will all have been introduced downstream from Chicago. If other lines are blanked or test signals are inserted at other locations, the noise performance of each segment of the network can be determined from measurements made at Seattle.

Routine checks can be made to measure variations in video tape recorder signal-to-noise ratio due to changes in head tip projection and wear, guide alignment, record head current, carrier frequency, tape formulation, tape wear, etc.

Measurements of the signal-to-noise ratio of a monochrome camera or of the Y channel or encoded output of a color camera may also be made by the VNM-428. Measurements of non-composite color camera R, G, and B channels may also be made if sync is added to the waveform. In all cases, the camera should be viewing a scene with large areas of uniform black, white, or gray, and minumum color.

It must be remembered when determining the signal-to-noise

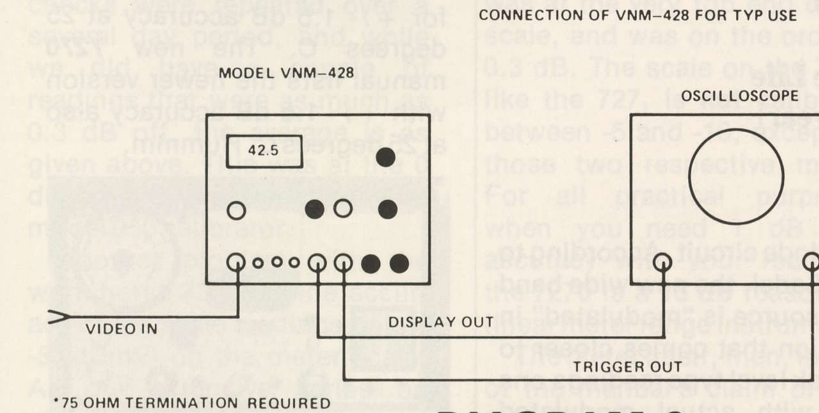


DIAGRAM 6

ratio of a camera, **measurements made during blanking** will not yield the information of interest, specifically the noise introduced by the pickup tube and preamplifiers.

CONCLUSION

This paper has attempted to show that there is now a device available to the television industry that brings the problem of signal-to-noise measurements out of the laboratory and puts it into the field where it belongs. It has been shown that you can select the best video tape, optimize VTRs and cameras, select the best camera tubes, detect gradual failures before they become serious, monitor network performance, perform proof-of-performance measurements on incoming equipment, **make FCC proof of performance tests on CATV systems**, and test the noise performance of any other NTSC system or piece of equipment.

Any television operation that prides itself on the quality of its signal needs to make periodic checks of the noise characteristics of their system. There is now a proven technique that makes this job easier and simpler than ever before.

TESTING PERIPHERALS FOR 1977

(New Things To Make Life Easier For You This year)

New Faces, New Tools

During the past year there have been a few new test equipment wrinkles in the industry, some of them make work easier, or more accurate. Some are changes which require us to update previous reports in **CATJ**.

Back in the June 1975 **CATJ** (page 29) we reviewed the **Sadelco** model 260-A **Analyst.** In that review we pointed out that the broadband noise source from Sadelco offered a low cost way for systems with signal level meters to make reasonably accurate wide band explorations of their systems, utilizing the noise source for an input signal and the SLM for a "receiver". As you wheel the SLM from the low end of your cable spectrum through the high end of your spectrum, invariably you will find changes in indicated 260-A noise level. The changes, plotted on a piece of graph paper, indicate where the gain or loss of your system is **non-flat.** With the addition of the **CATJ** economy analyzer at many systems, the wideband noise source from Sadelco offers an excellent method of doing system or channel response testing with a **visual** real time display, the low cost analyzer replacing the hand sweeping of the SLM tuning dial and the CRT display replacing the written point for point graph paper log of the display. During the past year Sadelco has revised the production design of their 260 Analyst and the result is a 260-**B** version. The primary difference between the "A" and the "B" is a redesign of the noise (generating) diode circuit. According to Harry Sadel, the new wide band noise source is "modulated" in a fashion that comes closer to the peak level type readings one finds with actual modulated television carriers. This improves the accuracy of the noise source as an **absolute** source. The change is not dramatic, but it is a significant step forward for people who want the best accuracy they can find to make their tests.

The 7270 SLM

When Texscan and Jerrold went their separate ways this past fall, everyone wondered what would happen with the test equipment line manufactured by Texscan but marketed by Jerrold. Well, it appears that the test equipment line, or at least major portions of it, are now offered under the Texscan/Theta-Com brand. An example of this is the tried and true 727 signal level meter. This unit, first offered by Jerrold some nine years ago, is without question **the workhorse** of the industry as far as field and headend measurements are concerned. When we reviewed the instrument in **CATJ** back in our **December 1974** issue, we pointed out that our major disappointment with the unit was that it was **then** seven years old, and we felt that while it was a good meter, that some changes had taken place in the interim seven years since it came out, in the state of the art of the industry.

With the unveiling of the Texscan version (cleverly called the **7270**) comes a couple of noteworthy changes in the instrument. On paper they look just great. For example, in the **727** meter, the unit's spec calls for + /- 1.5 dB accuracy at 25 degrees C. The new **7270** manual lists the newer version with + /- 1.5 dB accuracy also at 25 degrees C. Hummm.

Texscan/Theta-Com Model 7270 SLM has new peak detector and 90 dB rotary attenuator in 10 dB steps.

Yet the newer 7270 has a much changed and much modified (actually re-designed from the ground up) detector circuit. In fact, **it is a peak reading detector** employing three IC's, a high impedance meter driver transistor, and a balanced detector employing some of those good quality HP 2800 diodes. Seemingly, with that kind of approach to mid-70's type technology, the 7270 **should have** better meter reading scale accuracy than + /-1.5dB accuracy.

For those who do not have access to the **December 1974 CATJ,** we found the 727 checked at that time had the following **absolute** level accuracy:

Channel	Accuracy
2	Read 1.2 dB **high**
6	Read 1.4 dB **high**
7	Read 1.1 dB **high**
13	Read 1.0 dB **high**

In all cases we **were** within the spec of + /- 1.5 dB. Using the same reference source (our Lab's **Edison Electronics Model 950** signal level meter calibrator), with the **7270** we found:

Channel	Accuracy
2	Read + 0.1dB high
6	Read + 0.1dB high
7	Read 0.0 dB off
13	Read 0.0 dB off

Frankly, of all meters checked to date, this is **as high a rating** as we have seen. The checks were repeated over a several day period, and while we did have a couple of readings that were as much as 0.3 dB off, the average is as given above. This was at the 0 dBmV input level, from the model 950 calibrator.

Another problem with the work horse 727 was the accuracy of the scale readings below -3 (dBmV) on the meter scale. As our extensive series on signal level meters pointed out more than two years ago (**See October, November, December 1974** and **January 1975** issues of **CATJ**), virtually **all** meters experience a linearity problem in the lower portion of the scale (i.e. far left portion). In a nutshell, readings taken left of center are **never** as accurate in terms of absolute levels **or** relative dBs as readings taken at center or right of center. In the 727 checked some two years ago, we found that below -3 on the scale, the error was greater than the spec (+/- 1.5 dB) allowed. In the 7270 tested, we found this **not** to be the case. Utilizing a lab quality 1 dB step attenuator ahead of the 7270, we took the 7270 input level down from +10 dBmV (from the 950 calibrator) to -5 dBmV. Here is what we found:

Real Level	Meter Indicated Level
+10 dBmV	+ 9.7 dBmV
9 dBmV	8.8 dBmV
8 dBmV	7.9 dBmv
7 dBmv	7.0 dBmV
6 dBmV	6.0 dBmV
5 dBmV	5.0 dBmV
4 dBmV	4.0 dBmV
3 dBmV	3.1 dBmV
2 dBmV	2.1 dBmV
1 dBmV	1.1 dBmV
0 dbmV	0.0 dBmV
- 1 dBmV	- 1.0 dBmV
2 dBmV	2.0 dBmV
3 dBmV	3.0 dBmV
- 4 dBmV	- 4.1 dBmV
5 dBmV	5.1 dBmV

The worst error found then, was at the very top end of the scale, and was on the order of 0.3 dB. The scale on the 7270, like the 727, is **not** calibrated between -5 and -10, except for those two respective marks. For all practical purposes, when you need 1 dB step accuracy with your readouts, the 7270 is a **15 dB** reasonably linear meter range instrument.

The meter itself, then, inspite of the manual's claim of +/- 1.5 dB accuracy (which may simply be a hold over from the identical spec in the 727 manual) **appears** to be much closer to a **0.5 dB accuracy** instrument. This should prove to be a very-worthwhile improvement for 727-family fans.

The other major change is in the attenuator system. The 727 utilized a series of slide attenuators, one 10 dB slide switch and four 20 dB slide switches for a total of 90 dB front end attenuation. The 7270 replaces the slide attenuator switches (which must honestly be given only a middlin' rating for serviceability on the long haul, due to dust and moisture accumulation in the field) with a sealed rotary 90 dB attenuator that has 10 dB steps (see photo). This is a lab quality attenuator, and it should prove to hold up well in field use.

Other than that, the 7270 is your basic 727. The manual is virtually unchanged (it was an excellent manual going in), only minor physical changes have taken place (other than the removal of the slide switch attenuators the major change is in the decor of the outside of the cabinet front door panel reflecting the Texscan/Theta-Com new label and name).

The **UHF** head is **not** currently available from Texscan/-Theata-Com, but we understand Jerrold **still has** a fair supply of the UH-727 heads available. A superband head for channels J through 300 MHz is available from Texscan/Theta-Com as the SB7270 head. **NO**. . .older 727 meters can**not** be updated, modified, etc. by you nor by the factory (we say can**not** be. . .are not being accepted for modification by the factory is more accurate; conceiveably, somebody **could** do the peak detector mod **if** they really knew what they were about). The price tag has gone up by about 8%, it is now a $895.00 instrument rather than a $825.00 instrument. A good portion of this increase is found in the lab quality 10 dB step rotary attenuator.

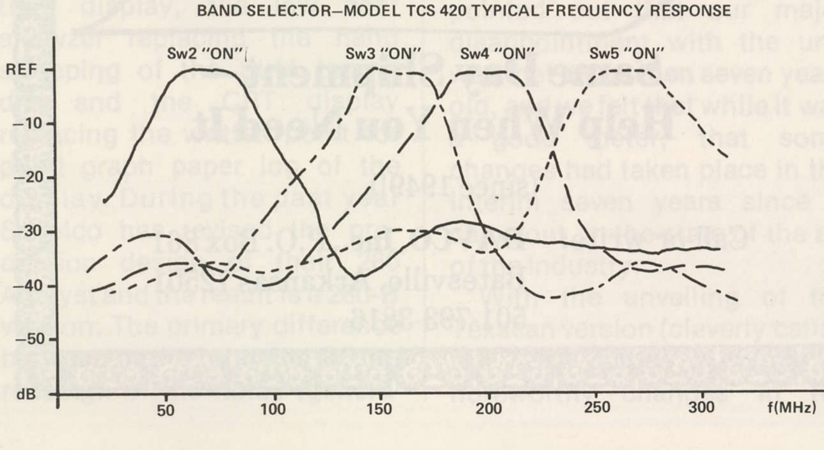
Interesting Canadian Additions

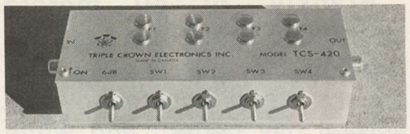
There are two rather interesting test equipment additions from Canada this year; and although not purely new since 12 months ago, neither has had wide exposure in the United States previously (although we know our Canadian readers are well aware of both). The two units are manufactured by **Triple Crown Electronics, Inc.** (42 Racine Road, Rexdale, Ontario M9W 2Z3; 416/743-1481).

The model **TCS-20 Band Selector** has more applications than you can throw a stick at; primarily, it is a test bench instrument that allows you to throw a switch and select any one or more (up to four) bandpass segments through the device. There are five switches on the TCS 420 (see photo); Switch one is a 6 dB pad; switch two is a low band passband filter. Switch three is a midband passband filter; and switch four is a high band passband filter. And finally switch five is a superband passband filter. The insertion loss is 0.5 dB at 300 MHz for the full unit with all switches out or off, and the return loss (match) is 18 dB. Ripple throughout the 50-300 MHz passband is plus or minus 0.25 dB worst case.

The individual selectable passbands are shown here in diagram form. The unit was designed as an operating accessory for the Triple Crown Model TCS 1800 Multi Channel Signal Source, but on the test bench the ability to switch in and out desired passband responses is very useful when aligning broadband amplifiers or switching in and out mid or super band sources and alignment equipment. While the unit is factory aligned similar to the

BAND SELECTOR—MODEL TCS 420 TYPICAL FREQUENCY RESPONSE





Triple Crown Electronics' TCS-420 switchable passband filter covers low band through superband in four steps.

responses shown in the diagram here, the adjustments for alignment of the passband sections are largely available through capped top panel holes and touch up, or re-alignment to other nearby segments of the band, is apparently no big deal. The price is $95.00 per TCS-420 unit.

The other item of interest will have limited appeal; but for those systems or MSO engineering shops required to perform intermodulation or cross modulation checks, the TCS-1800 multi-channel signal source is certainly worth looking into.

Basically, what you have in the TCS-1800 is a series of quality signal sources, packaged 8 to a rack. The signal sources may be 15.75 kHz modulated so that you have a source of modulation for performing cross mod checks. A total of up to 32 fully operational test channels may be stacked into the package, representing a **full** spectrum from 50 through 300 MHz. Each RF module in a basic package of 8 modules has a crystal controlled oscillator, modulator and bandpass filter. The depth of modulation on each RF channel is adjustable and individual signal level adjustments are also provided for each RF channel. Provision is made for external video modulation source (to complement the internal 15.75 square wave source) and for the addition of externally developed signals (such as CW pilot carriers). A fully descriptive manual describing the operation of the unit and tests you can perform is available from Triple Crown Electronics; the price of the 8 channel package is $2250.

CATA TEST PROGRAM FOR 1977

(More and Better)

Not Just Another Year

As is repeated often throughout other test related features this month, **1977 is not just another year**. It is a more serious year, but it is also a more difficult year to make a decision concerning testing.

For example. . .the FCC has been trying to wrestle with the matter of defining "what is a cable television system" for some months now. Way back in October they were scheduled to take up the pending review of system definition; but they never got to it. Then in November and then in December. It did get some talk late in December, just ahead of Christmas; but not a final decision. Now here is what that does to you.

(1) **Suppose you have 249 or fewer subscribers.** Based upon all of the "intelligence" everyone seems to share, the chances are about 100 to 1 **in favor of** your **NOT** being a cable system; after the FCC finally gets their decision making hat on. That means **no** FCC tests, **no** more FCC forms, **no** fear of FCC inspections. **No** more 325's, **no** more 326's. . .and **no** more Gridley.

So what do you do right now about tests? Do you make them? Do you plan to make them? Do you even go so far as to order a $25.00 CATJ Cookbook for 1977 tests? If you are a betting man, you don't spend even $25.00 for a test cookbook; unless you just like to have it handy as a reference manual.

And you sit and wait. And you think to yourself "boy I wish they would hurry up and make that determination, because I don't want to be a cable system any longer. . .".

(2) **Suppose you have between 250 and 1,000 subscribers.** Based upon all of the intelligence that seems to be "leaking" out of the FCC, the chances are about 10 to 1 that after the FCC finally makes this much awaited decision, **you will still be some type of cable system**; but (and this is a big but), you **may** not have to file **all** of the forms or make **all** of the tests that you presently do. That is a **may**, not a certain fact.

But until the decision is made; until you know for sure whether you are a cable system first class, a cable system second class or maybe even not a cable system at all (there is a slim chance this could happen), what do you do? Do you contract with somebody to come in and make the 1977 tests? Do you buy new test equipment that you don't really need unless you are making required tests? Do you even buy a CATJ Test Cookbook?

All good questions. There are no answers late in December.

(3) **Suppose you have 1,000 subscribers or more.** Again, based upon all of the "intelligence" gathering apparatus at the disposal of the industry, the odds are around 100 to 1 that **what you are now** is **what you are going to be** after the much awaited decision is made. In other words, with more than 999 subscribers off of your headend, for test and technical compliance purposes, **you will still be doing this year** (and next year) what you should have been doing last year. Making tests, proving compliance, and using all of those manuals and textbooks and equipment.

Now last year, to help our typically smaller system, CATA put together a complete set of test equipment. We made arrangements with Mid State Communications in Beech Grove, Indiana to package up some gear from Tektronix, from Wavetek, and from Mid State. The gear was in fact a "test set", allowing cable system operators to use this "test set" to make all of the required tests. Approximately 40 companies used the gear through 1976, although many more than 40 CATV systems got checked with the gear. The program worked pretty well. We found out that most people could make the required tests in 3-4 days time on a single system; and that two people working together as a team could do two systems in 4-5 days time; if the systems were close together.

The **CATA Test Equipment Package** is again available this year. We are now taking "signups" and there is an order card for same between pages 8 and 9 in the front of **CATJ** here this month (opposite page 9).

Here is what it entails.

(1) You receive the full test equipment package, allowing you to make all required tests. The test equipment this year includes the **CATJ** economy analyzer, a triggered sweep package and for radiation tests the new Mid State Communications "Cuckoo" package.

This is new gear this year, in addition to the SLM, signal generator/calibrator, Tektronix scope, frequency counter, counter / stripper / processor and the two-way radio package (VHF FM). Everything you need, plus. . .

(2) Each system participating in the **CATA Test Equipment Program** also receives a customized step-by-step set of instructions; a complete manual, of around 100 pages, that tells you **what** to do, in **what** sequence, and **where,** to make all of the tests. The Test Manual is provided in duplicate, and it includes test logging forms on which you record the tests as you make the measurements.

The price for 3-4 days of testing time with the package is $500.00 for CATA member systems and $600.00 for non-CATA member systems. And . . .and this is also important, if you have a "buddy", a system down the road or over in the next county that wants to work with you on your tests (and you with him on his tests), you get the gear for five days time and the second (or "buddy") system gets his own customized manual also. The extra charge for the second system is $125.00 on top of the base rate for the first system.

In 1976, of the 40 or so CATV companies that made the tests utilizing the **CATA Test Equipment Package,** approximately 50% had fewer than 1,000 subscribers. This group of systems, as well as others who are in the same size-categorey, **may** not have to do anything this year. We won't know until the FCC makes that fateful decision.

So what do you do **now?** If you are interested in being a part of the 1977 **CATA Test Equipment Program,** but you are not sure because of your system size whether you will actually be required to make tests (or all tests) this year. . . may we suggest that the first thing to do is to call or write us at **CATJ** and have your name put on the list as a **"tenative"** sign-up. That means we know you are interested, and will in fact take the package **if** it turns out after the FCC gets all of their decision making done that you do in fact **need** to make the tests.

And if you are over the 1,000 subscriber point. . .well, the odds are 100 to 1 that you are stuck with the tests, **so there is no time like the present to sign up!** Now last year (1976) there was no way that we could bicycle the equipment around to the 40 plus systems between January 1 and March 31; so CATA obtained from the FCC special permission to allow those systems who would be receiving the equipment, on schedule, **after** March 31 (1976), the right to have waived the March 31 deadline date. The same practice applies this year. Sign up, and we will work out a schedule that makes sense to everyone involved.

And good luck!

PLANT DESIGN TO SAVE $$$

Editor's Note:

For as far back as we can remember, CATJ has *not* made it a practice to reprint material appearing elsewhere previously. However, for every rule there is an exception. This article originally appeared in the March 1976 issue of Cable Communications, a Canadian publication that includes circulation within the CATV industry in Canada. We must assume most of our Canadian readers have read this technical paper, but we feel it is too good to allow to pass unnoticed by our American readers, or those in 30 other countries where CATJ is received. This paper was originally written by David Emberson, of Hamilton, Ontario.

In the past, most systems have been operated using one of two basic methods, both of which exhibit different merits, disadvantages but similar results.

As many factors have changed recently, it becomes necessary to evaluate these changes. And in understanding the aspects of these two methods, and in the application of these new developments, it is possible to combine the best of both methods, forming a third method of system operation and — or, design.

METHOD #1

System operation based on "Input Oriented Levels" was applied to early systems utilizing tube type amplifiers to insure that the input levels were maintained, preserving the signal-to-noise throughout the system.

As most systems carried only a few channels, the only indication of output capability was perceptible Cross-Modulation.

High output levels were more often detected by the resultant "sync clipping", which caused pictures to roll vertically. The lack of Automatic Gain Control (AGC) circuitry and the instability of electron tube circuits caused the amplifiers output levels to vary constantly, usually decreasing as the tubes aged. It was necessary to maintain proper input levels to prevent serious degradation of the system signal to noise.

Output levels of preceeding amplifiers were adjusted to ensure proper input levels to the following amplifier and these input levels were maintained as flat as possible across the spectrum. The output levels of distribution amplifiers were maintained at higher levels closer to the beginning of the system allowing distortion products to increase more quickly to permissible levels, while distribution levels toward the end of the system were reduced relative to the amplifier cascade by which it was being fed. In this manner an attempt was made to maintain the levels of distortion throughout the system.

Early transistor systems were operated along similar lines, however, because of substantially lower output capabilities, maximum output levels decreased, thus reducing the operating gain of these early transistor amplifiers.

The design and maintenance of such systems was complicated and difficulty arose in allowing the use of the amplifiers maximum output capability because high input levels which could result in the generation of distortion products within the input or intermediate stages of amplification, due to erroneous allocation of Slope and/or Gain controls.

The technician had to understand the amplifier design to be able to accurately determine the operating levels for every distribution amplifier location, or he would constantly refer to his own field notes, which were always being up-dated to permit compensation for line loss changes and temperature fluctuations.

The main advantage of this method was in the full utilization of the capabilities of every distribution amplifier in the system.

METHOD #2

System operation based on "Output Level Orientation" was used to reduce the incidents described in Method #1. In method #2 each amplifier of a specific type operated at the same output level regardless of its location in the system. The input levels were allowed to vary over a range that was mainly determined by the range of the Slope and gain controls of the amplifier. Typical levels in such system could be as shown below:

(The below levels were also determined by the degree of channel loading on the system).

These levels were normally calculated for "worst-case" situations at the end of the system with a fixed number of line extenders permitted. These same operating levels were then applied throughout the entire system to ensure a

Amplifier Type	*Ch. 2*	*Ch. 13*
Trunk output (DBmV)	+25 to +30	+27 to +38
Trunk input (DBmV)	(+10 to +17 depending on slope)	
Bridger output (DBmV)	+34 to +38	+40 to +48
Line Extender output	+34 to +38	+40 to +48
Line Extender input	(+18 to +30 depending on slope)	

system would operate within the permissible levels of distortion used in the "worst-case" calculation. While this method contributed to the simplicity of system design, wasted amplifier capability is considerable unless distribution lines are extended beyond the "predetermined number" of allowable line extenders. Provided, of course, that the output levels can be maintained using either thermal level compensation or automatic gain control. Without such controls the maintenance of these extended line extender cascades becomes more difficult with signal and temperature fluctuations.

It is necessary that the designer be aware of the various distortion factors so that he may appreciate the convenience and so use the necessary design charts provided by the systems engineers.

CURRENT AMPLIFIER DESIGN

During the past four years advances in solid state devices has produced the hybrid broadband amplifier specifically designed for use in CATV amplifiers.

These devices generally surpass the performance of discrete transistor amplifiers.

Many such devices have been produced each exhibiting different performance characteristics for noise figure, gain, bandwidth and output handling characteristics.

Knowing the layout of the system, it is possible to calculate the specifications necessary in each group of amplifiers, to ensure that the permissible distortion levels will be met in any specific location within the system.

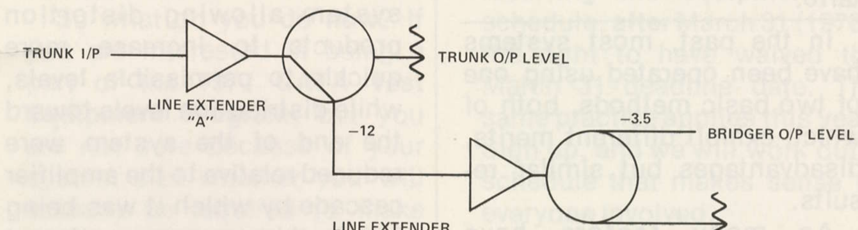
TRUNK/BRIDGERS VERSUS LINE EXTENDERS

In reviewing the individual specifications for amplifiers it becomes apparent that line extenders using state of the art IC's can perform as good or better than classical trunk amplifiers using "non-IC" design and will equal state of the art trunk amplifiers in terms of I.M. performance.

It was suspected that the differences between the Trunk/Bridger Combination and the current high quality line extenders should be very slight.

In the past, manufacturers such as C-Cor produced separate units containing trunk amplifiers and bridger amplifiers in separate housings and coupled the two feeding the bridger amplifier from a feeder port on the trunk amplifier.

Such a configuration was



simulated using two current line extenders with "outboard" couplers and splitters, resulting in a two output bridger/-trunk combination.

The performance of these line extenders was then directly compared to that of a trunk/-bridger combination.

The line extender configurations shown using the outboard couplers splitters in Figure #1 here—

The results of the comparison are shown in chart #1.

"B" were adjusted for a flat output from channel two to 300 MegaHertz of +49 DBmV on both outputs to facilitate the test set-up.

Tests were made using an EIE (RCA) A-B coaxial switch to ensure equal conditions for all measurements.

POWER CONSUMPTION MEASUREMENTS

Power consumption is also compared using a 60 volt sinusoidal transformer and

PARAMETER MEASURED	*TC*	*LE*
Bandwidth	50-300	50-300
Frequency Response	+.25	+.25
Distortion Characteristics		
Superband Composite T.B./S.O.	—68	—65
Highband Composite T.B./S.O.	—58	—63
Midband Composite T.B./S.O.	—55	—65
Lowband Composite T.B./S.O	—65	—67

CHART #1

It was noted during the tests for triple beat and second order, that the grass or noise level along the base line of the display decreased about 2 dB for the line extender combination indicating a slight improvement in signal-to-noise ratio over that of the Trunk Combination.

Both the trunk amplifier of the Combination and Line Extender "A" were adjusted to the trunk levels previously shown with Channel Two output at +25DBmV, Channel Thirteen at +29 DBmV and 300 MHz at +31 DBmV.

Current line extenders have almost 30 dB of gain while the required operation for trunk transportation is closer to 20 dB of gain. It is necessary to reduce the gain of the line extender without excessive detriment to the noise factor of the amplifier and this is best accomplished by use of an interstage attenuator.

The Bridger Amplifier of the combination and Line Extender

measuring the voltage drop through a .51 ohm, 1 watt resistor.

The Trunk/Bridger Combination produced a voltage drop of .14 volts indicating a current draw of approximately 275 M.A.

The Line Extender Combination produced a voltage drop of .12 volts indicating a current draw of 235 M.A.

While this is not to be considered an absolute reading, it does indicate the power consumption is almost equal using this particular type of line extenders. These results are expected to vary with different models from various manufacturers.

The passive devices used were of high quality, fused for AC powering and using VSF type connectors to facilitate the assembly of the units. Mating of the units for line installation was easy and the final assembly resulted in quite a visually acceptable package with all the mounting brackets falling "in-line".

Both the Trunk/Bridger Combination and the Line Extenders were capable of two-way operation.

SUMMARY

In this particular case the equipment used in the Line Extender configuration were: (a) Triple Crown Line Extenders DL350/DL352 and (b) Anaconda Model 2400 series Couplers and Splitters.

Some of the reasons for using these particular units are as follows:-

(a) *Line Extenders*

(1) The Triple Crown Line Extender contains an inter-stage attenuator, which permits gain reduction of the unit to about 22dB of gain for the Trunk Amplifier.

(2) The unit is competitively priced and readily available.

(3) The unit is also available with inter-stage AGC.

(b) *Couplers/Splitters*

(1) Fusing is important in system design and the Anaconda 2400 Series Couplers/Splitters use a standard AG type fuse (available at most garages and service stations). The entire system can be fused to permit isolation of areas suffering AC problems.

(2) LED indicators are available to give a visual indication of the powering.

(3) The boards in these units can be changed or replaced without need to change the housing or the connectors.

These two types of units, when mated together, mate quite nicely and permit easy access to the test points of the amplifiers, both input and output.

CONCLUSION

This exercise began by comparison of distortion products of amplifiers. The tests, however, resulted in some rather pleasant surprises!

(1) The results of chart 1 were impressive.
(2) The esthetic appearance of the final assembly is quite acceptable.
(3) A cost savings of approximately 60% can be realized, and cannot be ignored, and the amplifier performance is equivalent or even better.

Knowing that manufacturers of high level line extenders are using the best "state-of-the-art" devices, new and different ideas in System Design may be generated, maintaining BP23 levels while also realizing substantial cost savings.

CATJ LAB REVIEW

Western's Log Antennas

Super Light

More than one year ago a truck from **Western Communication Services** (San Angelo, Texas) pulled up at that **CATJ** Lab north of Oklahoma City and dumped off a quad-set of four high band logs. The truck was on its way with around 200 feet of tower on board to put in a CATV headend for a new system out in western Oklahoma; and the antennas were "on loan" for a **CATJ Lab** evaluation.

Well, winter set in and the antennas never quite got up. They laid in a pasture for awhile, and when some horses started tripping over (and stepping on) the aluminum elements, we decided that the best thing to do was to get them out of the pasture and on one of the towers. Which we set out to do one Sunday in February. The antenna array was bolted together and ready for tower raising when the Oklahoma weather soured and we had to pull back for the time being.

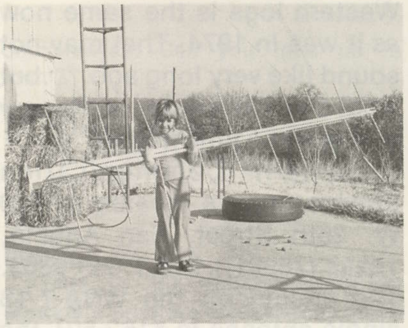
Time being stretched out. . . so that come summer time the assembled, but not installed array was still laying around at the base of the tower. Western's Richard Killingsworth was understanding but anxious to have our evaluation.

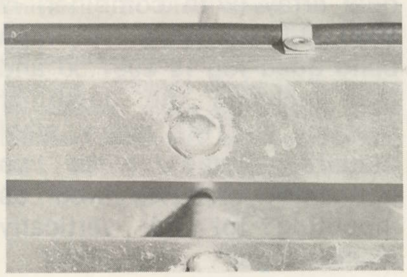
Recently we finally got the antennas installed and checked out. Now Western Communication Services manufactures a rather extensive line of welded aluminum logs; covering the usual selection of low band channels (such as 2-4, 4-6) and high band channels (7-13) and so on. The antennas we have borrowed for the past year-plus are the (individually) WSA-7-13 logs; but which in a dual of two (like in a two stack array) are the WDA-7-13 and in a quad array the WQA-7-13. We checked the four antennas we had on hand out all three ways; alone, as a dual array and as a quad array.

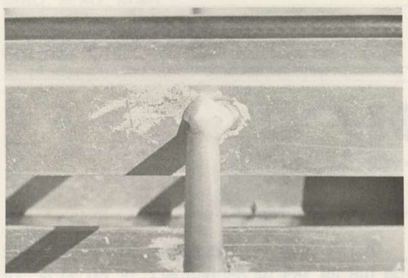
The first thing that surprises you (we hesitate to use the word amazes) is their lightweight. We've seen some mighty light logs (such as CADCO's assemble-it-yourself version) and some mighty heavy logs (such as Scientific-Atlanta's built-like-a-battleship versions). We have wrestled with these and others on towers and as an experienced tower hand who does not hesitate to take 200 pounds of man 200 feet in the air to tighten an F fitting or hang out on a rope line for a couple of hours adjusting an array, we've tried to manhandle our share of antennas far above mother earth. The lightweight impressed us, although we were concerned going in that somehow light meant flimsy. Fear not, as we found out.

How light is a single stack of the WSA-7-13? Well, we rounded up a 42 pound 5 year old youngster who seldom lifts anything heavier than her Raggedy Ann doll and asked her to hold the antenna while we took the picture. We shot five photos in about three minutes time and she didn't complain. The truth of the matter is you can lift a single stack with one hand high above your head and not feel uncomfortable. People who have done gymnastic exercises on towers moving antennas around can appreciate that statement.

Now as for rugged. The logs are of conventional design; a pair of "U" channels inverted so the open mouth faces the open mouth on each half. Through the outside lip a hole is punched or drilled and the element inserted (see photos). On the opposite side of the U channel another hole lines up with the first and the element slides through that hole as well, flush with the outer wall. Then, as the photos show, the element is firmed in place with aluminum welding on both sides of the channel. That



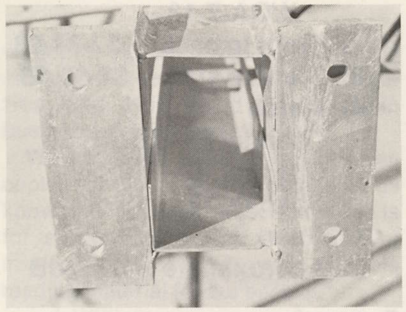


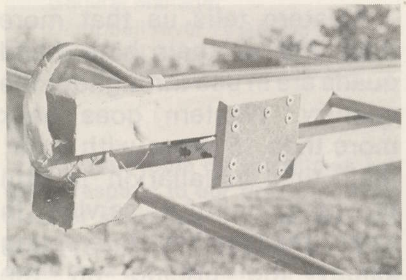


makes a stout connection, and even though we had an ugly experience with a couple of horses tromping all over the antennas one day (and bending a couple of elements), we had no trouble putting them back where they belong. You are not likely to have any problems with horses at 400 feet in the air, but a large bird or chunk of ice from a higher antenna on the tower could do some damage; and its nice to know the element is not likely to snap; only bend a little.

The back or "cold end" of the log has some pretty stout aluminum angle material welded into place to form two flat surfaces through which the mounting "U" or "C" bolts slide. The antennas are rear mounting, which means they fasten to the tower leg or the support pipes for the quad array when the antenna array is offset from the tower proper. Again, see photo here.

Western runs the feedline





(RG-6) from the nose (or "hot end" of the antenna) to the rear over top of outside edge (top or bottom support channel depending upon your point of view). It is held in place with a generous supply of riveted clips; running the coax back along the channel boom performs the decoupling exercise so necessary with logs (see **CATJ for September 1975**, page 25 for basic discussion of log antenna design). The photo here of the nose with feedline connection shows the way Western weatherproofs the connection between the feedline and the connection points; this is how cruddy it looked **after** a year of pasture duty, hanging around at the base of the tower and after finally getting up on the tower and then coming back down again.

Also note in the same photo that the insulation material holding the two channel booms in place is riveted into position with a surplus (i.e. generous number) of rivets. We did some "boom walking" on one antenna (close to the ground) just to see if it would support our 200 pounds out towards the end. It did.

Performance

Our dad used to say "How it looks isn't important son. . .it is how it works that counts". Our dad wouldn't know a log antenna if it bit him, but the statement is apt none the less. Western claims 12.0 dB gain for their WSA-7-13 antennas; and 18 dB of gain for their quad array. Now the text book says that when you double the size of the antenna array (i.e. from one stack to two stacks) that you can **theoretically** pick up 3 dB of additional received signal voltage. But in practice, if you gain 2.5 dB you should count your blessings. So if one has 12.0 dB of gain (that's possible), two would have 12.0 **plus** 2.5 **or** 14.5 dB of forward gain. And if you had 14.5 dB of forward gain with two, then four antennas (double two) would be 14.5 **plus** 2.5 **or** 17.0 dB of gain. That is 1 dB less than Western quotes.

In practice, we found that we could not tell whether a single antenna had 12.0 dB of gain over a tuned dipole; or 11.5 or 12.5. That is simply too close to call unless you are willing to calibrate the antenna test range (something we were not prepared to do on a Sunday afternoon). Western provides a four port coupler (i.e. a hybrid splitter used "backwards" as a combiner) for the quad log array; and for the quad array they also supply (as part of the package) a welded and painted steel support structure to allow you to hang those two away-from-tower members of the quad installation. (We seem to recall that Scientific Atlanta received some sort of patent on the so called 'diamond quad' array some years back; the 'diamond quad' being a particular approach to stacking four logs for an array that ends up being two antennas high by two antennas wide, with the two high members being mounted on the tower legs and the two wide members being mounted on the special clamped-to-tower supporting structure. How Western's mounting structure interacts with that patent is beyond us however.)

The steel support structure for the Western quad assembly is one heavy brute. The young lady pictured with the antenna could not lift even one end of it off the ground. Now normally you would haul it to the top of the tower or where you needed it with a winch line of some sort; it's not one of those strap-it-on-your-back and climb jobs.

When we got the quad array hung we made some measurements of the way it performed; again, subject to the non-calibration of the antenna test range **on that particular** Sunday.

(1) **Antenna** — Western WQA-7-13
(2) **Front to back** — 32-34 dB
(3) **Front to side** — 33-35 dB
(4) **Match**
Channel 7 — 18 dB
Channel 10 — 19 dB
Channel 13 — 19 dB
(5) **Gain**
Approximate — 17.0 dB

Synopsis

Western tells us that more than 200 of their high band quads are in use throughout the country. Western goes back more than 15 years with logs; their first installation is still providing faithful service in west Texas. One interesting aside; the pricing on the Western logs is the same now as it was in 1974. That may not sound like very long ago. . .but what else has stayed stationary in that same time frame?

Western Communication Service, Inc. is located at 320 W. 26th Street, San Angelo, Texas (76901); 915 / 653-3363. The pricing on the WSA-7-13 single antenna is $162.50; the dual array (with combiner) is $335.00. The WQA-7-13 high band quad log is $907.50 and that includes the combiner system, and the heavy steel mounting frame for the two horizontal logs as well as mounting for the vertically stacked logs.

TECHNICAL TOPICS

A FULL DIAL

Virtually every month there are a couple of new television stations beginning operations at some point in the United States. And while most new stations are non-commercial (ETV), there are still occasional additional commercial stations showing up on the already crowded airwaves.

The limitation for new station growth is largely the limitation of the ''Allocations Table'' adopted back in 1952. By allocating VHF and UHF channels on a community by community basis, the FCC opted to avoid the AM radio approach where new stations are squeezed in only where it can be shown the new operation will not create specified amounts of interference to existing AM stations.

There obviously must be an end to such expansion, in as much as the 1952 allocations table is inflexible. At the present time there is an FCC study underway which would re-structure the allocations table in many regions of the country, by ''short-spacing'' some of the VHF channel assignments, and allowing hyphenated markets to utilized adjacent channels (example: Channel 8 to Dallas, channel 9 to Fort Worth). But this is still ''study'' and most observers feel that very few such ''short-spaced'' allocations are likely to fly at the Commission, given the resistance of the existing telecasters to allow their present allocations to be changed.

So where are we with the present allocations table?

The following data is illustrative of that question:

Commercial Channels:

Markets	V Allocated	V On Air	U Allocated	U On Air
1- 50	161	161	185	63
51-100	111	111	144	50
101-329	236	224	217	75

Thus in the top 100 markets, there are no VHF channel allocations not operating. In the top 50 markets there are 82 UHF channels either not operating, not in ''CP'' status or not applied for. In the 51st through 100th markets, there are 83 UHF channels either not operating, not in CP status or not applied for. (In the top 100 markets there are 35 UHF stations authorized [i.e. CP] but not operating, and 16 additional channels ''applied for''.)

In the 101st through 329 ''markets'' (it is still difficult to understand how Ely, Nevada and similar town's with assignments can be considered ''markets''), there are 14 VHF channels available for commercial assignment, and 293 UHF channels available for commercial assignment.

What about the ETV channels?

ETV Channels:

Markets	V Allocated	V On Air	U Allocated	U On Air
1- 50	29	26	97	52
51-100	19	19	67	26
101-329	51	41	190	74

In the top 100 markets, there are 3 VHF ETV assignments un-used (all in top 50 interestingly enough) and 72 UHF assignments. In the 101st through 329th ''markets'' there are 9 un-used VHF ETV assignments and 103 un-used ETV assignments.

Nationwide then we have but 26 un-used VHF assignments, **commercial or ETV**, of which 12 are ETV. And we have 468 un-used UHF assignments, of which 293 are commercial and 175 are ETV.

There are presently 70 authorized (but not operating) television CP's outstanding, of which 53 are commercial (5 VHF and 48 UHF), and, 17 are ETV (3 VHF and 14 UHF). We also have 38 channels applied for but not granted, 24 are commercial (all UHF) and 14 are ETV (1 VHF and 13 UHF).

Of 1517 channel allocations, 915 stations are on the air (as of September), or 60.31%. Of 1061 commercial allocations, 677 stations are on the air, or 63.81%. Of 456 ETV allocations, 238 are on the air, or 52.19%.

Of the remaining VHF allocations (all ETV) in the top 200 ''markets'', here is how they shape up:

Dallas-Fort Worth-(Denton) .....Channel 2
Denver-(Boulder) ....Channel 12
Salt Lake City-(Ogden) ....Channel 9
Amarillo ....Channel 2
Minot, N.D. ....Channel 6
Billings, Mt. ....Channel 11
Casper, Wy. ....Channel 6

A number of markets have substantial (unused) UHF allocations remaining. In the top 100 markets Los Angeles has 3, San Francisco, Cleveland, Houston, Baltimore, Miami, Atlanta, and Indianapolis 2 each, Seattle, Tampa-St. Pete 3, Hartford (et al), Kansas City, Denver Nashville, New Orleans, Providence 2 each, Oklahoma City, Greenville (et al, Charleston (et al) 3 each, Grand Rapids, Norfolk, Wichita 3 each, Wilkes Barre-Scranton, Toledo, Omaha, Shreveport, Richmond, Raleigh 2 each, and so on. Salt Lake City has five unused UHF commercial allocations and Orlando-et al market has five unused UHF allocations plus a sixth recently-dark UHF. Another with a pot-full of un-assigned UHF channels is Springfield-Decatur-et al (Illinois), with 1 v (used) and 8 UHF allocations, five remain unused.

Kraus Who?

"In your March CATJ there is an instructive article beginning on page 9 entitled 'The AGC Antenna Family'. In this article there are several references to the 'antenna genius Kraus'. This suggests to me that this 'genius' may have published some good works, copies of which should be on our bookshelves. Can you lead us to them?"

Damien Lemay
Quebec-Telephone
Rimouski, Quebec
G5L 1W7

Damien:

Kraus is the 'father' of many important antenna discoveries; much of his work has been done from the University of Ohio where he holds forth, as Director of the Radio Observatory. One of the best all around antenna reference works is 'Antenna Engineering Handbook', Henry Jasik (Editor), published by McGraw-Hill, Inc.; library of Congress number 59-14455. Kraus's works appears here.

Mad, Mad, Mad

"We have received one of your 'Dear Former CATJ Subscriber' letters and we are mad at ourselves for letting the subscription to the best CATV magazine slide. How could we remain in business without CATJ?

We had been subscribing to seven copies for the company; please let us know what the total subscription fee is for seven copies and we'll re-order immediately. CATJ is very valuable reading material for our people."

J. Williamson
General Manager
Campbell River TV Association
Campbell River, B.C.

JW:

Because people do sometimes forget to respond to our first announcement of subscription lapse, and our second gentle reminder, that is why we come back a month later or so with a 'Dear Former Subscriber' letter. Nobody likes to be a 'former' anything! Any outfit with five or more copies to the same address, in a single bundle, is entitled to 'Bulk Subscription' rates to CATJ. For more details about this 'Bulk' plan (which saves you money), drop CATJ's Peggy Jones a line at CATJ, 4209 NW 23rd, Oklahoma City, Oklahoma (73107).

Coop's cable column

bob cooper editor in chief
CATJ

Twinkle-Twinkle Little Bird

Well, it is done. In five months and 21 days, somehow, we pushed through the Commission approval for small earth terminals. It was quite an experience.

Several hundred people were involved at one point or another. A few stuck it out from the very beginning. I'm one of those.

At the Western Cable Television show in Anaheim in 1975 (that's a 5) I ran into a sales-engineering type from Prodelin at Santa Clara, California. His name was Jerry Pell. Jerry was in Anaheim without "portfolio", which meant he was drinking other people's beer because his company did not have a booth of their own. There was no reason for them to have one at Anaheim in '75, in the CATV product line the company had but a small number of CARS band microwave antennas, and in the fall of that year there was something less than a gold rush underway for that segment of the industry. However, in a file folder Jerry carried about a set of fading blueprints, for a 15 foot (4.57 meter) 4 GHz antenna. The word was around that Jerry was pushing "small earth terminals, but as Anaheim '75 was upon us there were but four or five operating CATV terminals, and they were all the big 10 meter S-A jobs. Jerry attracted my attention primarily because he had the gall to be suggesting that the CATV world didn't really need the big 10 meter antennas (something I identified with), and because he didn't seem to be in a big hurry. Plus he was fun to talk with. Anyone who has hauled home from work a $13,000 spectrum analyzer to tune up a rooftop 40 meter ham dipole can't be all bad. And Jerry isn't even a ham, his wife is.

In the rush of this past spring, our **CATJ** coverage of the Tulsa first-for-Andrew 10 meter dish installation (February 1976 **CATJ**) and the on-rush of NCTA's Dallas clambake, I allowed Jerry and his faded blueprints to slip into the back recesses of my mind. Until I ran into him again in Dallas, this time sitting in the TOMCO booth sipping on a beer and still carrying around the faded 4.57 meter 4 GHz antenna blueprints.

"How's the 4.5 meter business Jere?" asked I. Jerry sat his beer down on a TOMCO table and motioned for me to follow him out of Tom Olson's line of fire.

"We've got to get this program off the ground Coop." I nodded. "Got any ideas?" asked I.

"Some big people are interested" said he. **"People like TelePrompTer."**

"Anyone else?" asked I innocently.

"Try on HBO for size."

"Jerry" said I "there are a couple of people quietly operating or almost ready to operate terminals with 12-15 foot antennas. I've played with some surplus receiving equipment and a small 6 foot surplus antenna I scrounged through some Ham buddies. . .and there is some signal there, even with that lash up."

"OK. . .how do we get the FCC to allow us to use smaller terminals?" Jerry's employer Prodelin was kind of locked in on their 4.57 meter fiberglass design. There was some speculation that if you used fiberglass techniques and got into much bigger sizes than the 4.5 meter nominal area, there might be some problems. If Jerry Pell and Prodelin were going to get into the small terminal business, the FCC obviously had to get "off" of the 9 meter "standard".

And so Jerry and I and several cans of Coors worked out a plan. Prodelin would invest some bucks at their Santa Clara, California plant and put in an "experimental" installation (I tried to convince Jerry it should be at CATJ's Lab near Oklahoma City, but failed!). "Then if it works, and I think it will, we'll give the installation wide exposure in **CATJ**. If we show enough people that it does work and that the price is significantly lower than the present 10 or 11 meter antennas, I think we stand a chance of getting the FCC to change the standard."

By May Prodelin had an operating 4.57 meter terminal. The June 1976 **CATJ** reported on that event, and we spent several pages editorially, on purpose as it were, discussing why small terminals would be feasible and who was trying to do something about it. And then late in May while U.S. Congressman Lionel Van Deerlin was holding hearings with his House Subcommittee on Communications, we had a golden opportunity to focus "official" Washington attention on small terminals. Prior to the hearings, through a friendly intermediary, **CATA** had arranged for one of the Congressmen to ask us some "questions" while **CATA** was on the "witness stand" before the Van Deerlin group. The questions came during a period when **CATA** Counsel Rick Brown and **CATA** President Kyle Moore were offering testimony. Brown, on cue, motioned for me to join them at the front table. "Mr. Cooper is our Executive Director and Editor of the industry's technical magazine **CATJ**. He can answer your questions " Which I did, extolling the terrible situation small and rural cable system operators found themselves in; anxious to have "pay cable" and all of the other program services sure to be offered via satellite, but unable to pony up the then low-ball $70,000 entry fee. Congressman Van Deerlin showed real interest. So did Congressman Frey. And Van Deerlin directed his staff counsel to make a "formal inquiry" at the FCC as to "why there is a need for this 9 meter standard business." And that put the Commission "on notice" that **we were indeed serious** about small terminals.

Understandably, not everyone shared our interest in smaller antennas. The more noise we made, the more flack we drew. Bell was against us. ABC was equally upset with the proposal. And then came CCOS-76.

Way back in Dallas in April, Jerry Pell was one of the first to be told about CATA's plans to hold a "national seminar". "How would you like to demonstrate your 4.5 meter terminal to several hundred cable operators?" asked we of Jerry. His big hands tightened on the beer can he was holding and it collapsed. And so at CCOS-76 there was not one but two operating 4.5 meter (give or take a few tenth's of a meter) terminals, both the Prodelin and Andrew terminals worked so well that nobody seeing them operate seriously questioned their ability to produce cable-saleable pictures. And CCOS-76 came some six weeks **after** CATA had filed (on June 24th) a formal (meaning the FCC could not duck it) "Petition For Rulemaking or a Declaratory Ruling" requesting deep-sixing of the then 9 meter standard. CCOS-76 was also about the time that another early starter, Howard Hubbard of Antennas For Communications (AFC) pulled off a nice coup of his own for small terminals, Hubbard provided a small **horn** type antenna terminal, parked on the front doorsteps of Congress, so that during a later session of the continuing Van Deerlin hearings a cable man from San Diego could "testify" via satellite. This was a dramatic moment for cable, and Hubbard deserved **all** of the credit for making it work (**although he got very little credit**). Some time prior to that Hubbard demonstration, he had first contacted us. It was in March, right after **CATJ** did the story on the Tulsa installation by Andrew. **"You people think the sun rises and falls on those darn dishes"** offered the usually dignified Hubbard. And he proceeded to inundate us with stack after stack of engineering, performance and sales literature for his "horn antennas", the stack grew each week and now, some nine months after it first began to arrive, we are just approaching the bottom of the stack.

So there were three musketeers. Pell, his beer and his blueprints. Hubbard with his horn antennas (recall if you will that Gaithersburg, Maryland filed an application for a horn type TVRO back in February of 1976; it was a Hubbard/AFC horn); and me.

During the summer, as the project "matured" we became four. CATA's Associate General Counsel Steve Effros has always carried a more than casual interest in electronics. Steve's Washington apartment houses one of the finest quad stereo systems we have ever heard and the walls and shelves are lined with electronic this and electronic that. If Steve ever cranked up the volume control on his quad system full bore, the front gate guards at the White House, some miles away, would instantly sound the red alert. For years prior to his association with **CATA** he would seek me out at industry conventions and together we would wander the aisle ways of the exhibit floor pouring over the latest and newest technology the suppliers had to offer. Once in Texas at a Texas State Convention Steve pointed out a non-duplication switcher built by some guy in his workshop down Waco way. "It says it is fully automatic and needs no programming. What will that do to cable operators that are griping about non-dup protection mechanics" Steve wondered. We tried to dodge the issue but he saw through us. "Wait until I get back to the Bureau (he was employed by the FCC at the time) and tell them that you guys don't have a leg to stand on anymore!" One thing you have to observe about Steve; he always gives his full emotion to whomever it is paying his bills.

Fortunately for the cable television industry, **Steve was on our side** this fall. Single handedly, often without much formal help and armed only with alot of sheer guts and determination he stalked the halls of the 8th floor at the Commission answering this engineer's questions and putting out the brush fires. We'd hate to have to recount how many "ups" and "downs" small earth terminals went through during the progressing weeks of fall. One day "we had it made", and the next day "it looks lost". Steve arranged for numerous representatives of the earth terminal industry to meet with FCC officials and engineers, to see that questions and concerns and fears were answered; before they got out of hand and became a type of bureaucratic brushfire which rages so many places at once that you can't stamp it out. His electronics hobby bent served him well. . .during the fall, exposed to every possible engineering argument against small terminals, Steve Effros earned his "honorary degree in satellite engineering". He is the closest thing there is today to a walking-talking attorney in Washington with an engineer's appreciation for small earth terminals.

December 6th started out as one of those "up" days. Steve Effros was in Eugene, Oregon conducting a Mini-CCOS for CATA; I was in Washington. I had bumped into Howard Hubbard at one of those salesman's Holiday Inns by accident, and at breakfast we spent an hour congratulating each other on the good fortune of getting small terminals "almost approved". Howard was going to stay on until the 7th. . .he had seen it through this far and one more day seemed like a worthwhile wait. I went over to the Commission on some other business.

It was while I was there, sitting talking microcomputers with a nice fellow at the Cable Bureau that a flag went up. Copies of the December 7th document were out and being studied by numerous people in the Commission. **"See here, it says that there will be no restrictions on terminal size"** said our friend. We smiled. **"These standards are a little hard to figure however. . .".** We sat up straight. "What standards?"

"Right here, 14 dB carrier to noise, 18 dB carrier to interference. . .and 52 dB signal to noise. Can you do that with a small terminal?"

We turned white. 14 dB carrier to noise and 52 dB signal to noise didn't play. The very adequate CCOS-76 signals had maybe 10-11 dB carrier to noise (with threshold extension receivers) and perhaps 49-50 dB signal to noise.

Oops. The Lord giveth with one hand (no restrictions on terminal size) and taketh away with the other (14/52 dB etc.). We turned white, excused ourselves and beat it out of the building. Steve, our walking-talking entree card into any office at the Commission was out of town. General Counsel Brown was involved in a meeting he could not get out of, and Tuesday was only hours away. We put in a rush call to Howard Hubbard and explained part of the problem to him.

Then the CATV industry got lucky. By some fluke, bureaucratic snafu perhaps, someone had forgotten to "serve" the Broadcast Bureau with a copy of the December 7th document for "advance review". The Broadcast Bureau, on their own and with no prodding, primarily to exercise their muscle and show everyone they had power internally within the Commission got the matter postponed one week. They apparently had no real problems with the ruling; they just wanted to be served and recognized.

Steve's return from Oregon signaled our trotting out the big guns. Steve went right to Don Buscher of ITT Space Communications, Inc. and Don fired up his computer. Within minutes Steve was armed with every possible computer derived argument why 14 dB carrier to noise and 52 dB signal to noise **did not translate** to 4.5 meter dishes. It took Steve a couple of days of additional leg and mouthwork to convince everyone he had the real facts, but again Effros came through. When he got done and ITT's computer cooled down, the standards "that only a six meter antenna manufacturer could love" were gone.

And that's how it happened. 7-zip. Nobody opposed small terminals. And those were the people involved, give or take a few dozen other important people, some of who helped and some who got in the way, either accidentially or on purpose. And give or take a few thousand man hours of devotion by what was through it all a small cadre of people, some of whom never met or talked with one another through it all.

So when you get your first pictures spilling out of **your own** small terminal, **you might pause** a moment and gaze skywards towards the twinkling bird and say a few silent prayers for Jerry Pell and his beer stained blueprints, or Howard Hubbard and his persistence, or Steve Effros and his quad stereo system. And if you have a few seconds left over before the Mayor throws the switch activating your satellite delivered channel, you might say a few kind words for me also. As you are doing this with **your** new small terminal, **I** will probably be up to my elbows in ripped and bent metal as I continue working on re-surfacing a war surplus 15 foot dish I salvaged from some Ham friends this fall. One of these days the **CATJ** Lab **WILL** have its own operating TVRO small terminal. **I won't be satisified until we do.**

cata ASSOCIATE MEMBER ROSTER

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

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