AUGUST CATJ 1977

MICROWAVE ASSOCIATES' DANA ATCHLEY ENTHRALLED THE CROWD WITH LOW-COST MICROWAVE... WHILE TONY BICKEL AND OLIVER SWAN'S ANTENNA SEMINAR WAS VIDEO TAPED FOR MINI-CCOS DISPLAY.

A LOW COST SONY COLOR CAMERA SENT THIS PICTURE THROUGH THE LOW COST MICROWAVE.

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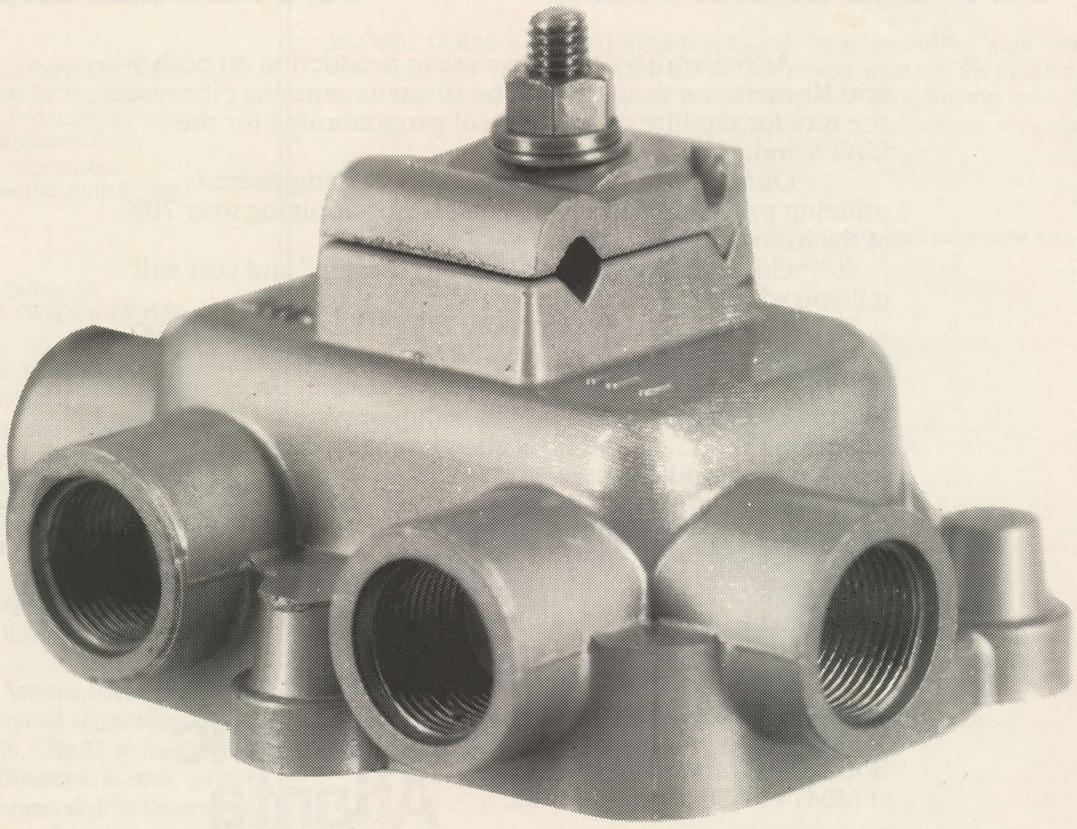

AUGUST 1977

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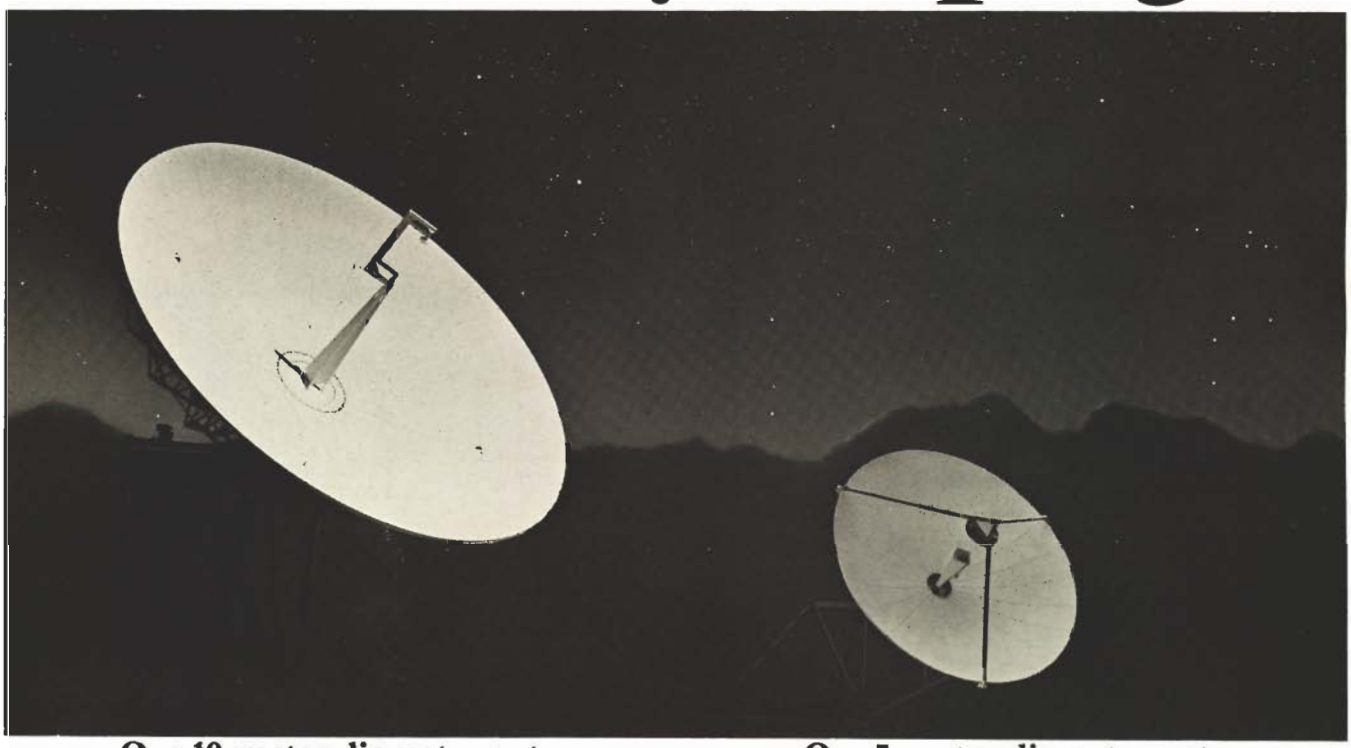

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CATJ

AUGUST 1977

VOLUME 4 — NUMBER 8

PUBLISHED MONTHLY, AS ITS OFFICIAL JOURNAL, BY THE COMMUNITY ANTENNA TELEVISION ASSOCIATION, INC., OKLAHOMA CITY, OKLAHOMA, AS A SERVICE TO ITS MEMBERS AND OTHERS PROVIDING CATV/MATV SERVICE TO THE TELEVISION VIEWING PUBLIC AND BROADBAND VIDEO/AUDIO DATA COMMUNICATION SERVICE.

OFFICES

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—FEATURES—

—DEPARTMENTS—

OUR COVER

CCOS-77 SCRAP BOOK. . .the full report of this year's industry-wide technical and operational gathering held in Oklahoma July 17-20 begins on page 12 here this month.

CATA-TORIAL

KYLE D. MOORE, President of CATA, Inc.

Orderly Transition

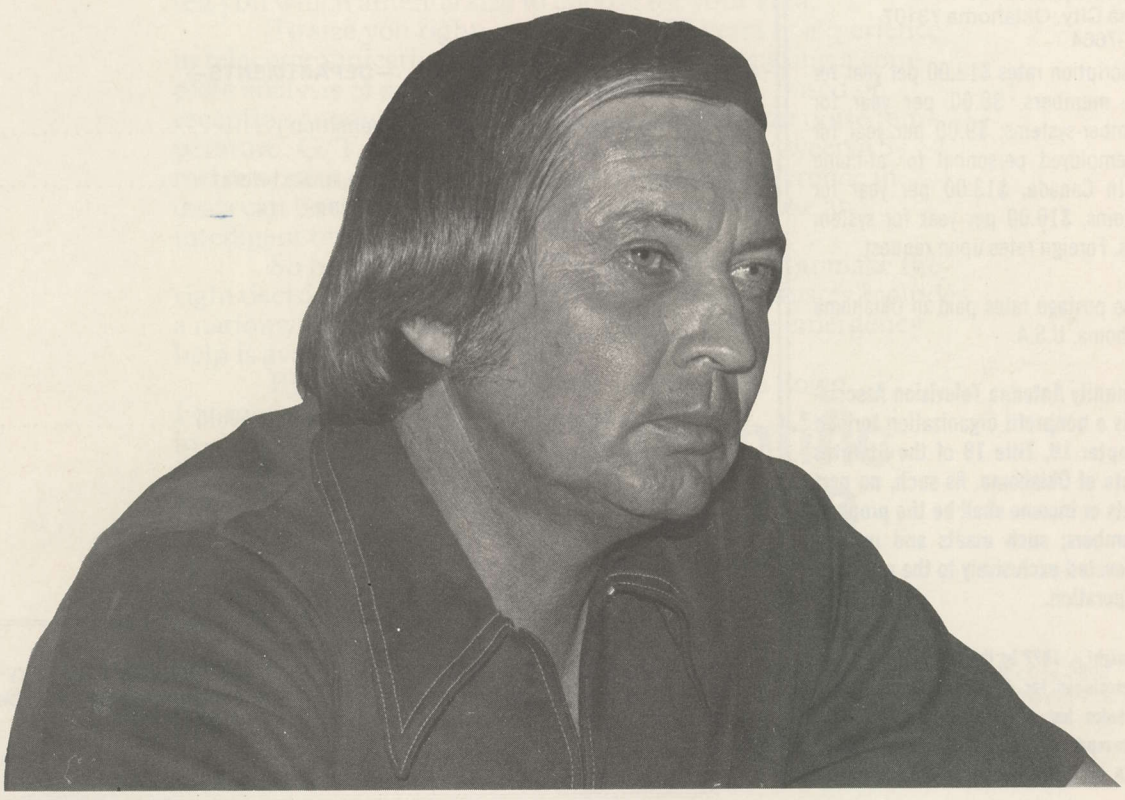
Slightly more than four years ago this month I and approximately 30 other non-aligned, concerned CATV system operators met in Dallas, Texas and CATA was born.

In the early days of formation little attention or concern was given to "what next" or "what happens after copyright is over". Our goal then was simply to stop or severely curtail the direction the copyright-for-cable march was headed.

Through the balance of the summer of 1973 and the fall of the same year CATA grew by opening a very small one-person office in Oklahoma City, hiring a young lady to coordinate mailings and answer the telephone, and by my personally traveling over some twenty five thousand miles of U.S. countryside to attend CATV meetings from Oregon to Pennsylvania and Michigan to Texas. The founders had determined that there should be a set of by-laws, there should be a non-profit corporate umbrella covering everything we might try to do as an organized group, and there should be an attempt to clearly define what it is we are and more importantly what we are not.

In the late winter of 1974 a group of operators, comprised of Warren Fribley from New York, Bill Risden from Kentucky, Ben Campbell from Texas and Bunk Dodson and myself from Oklahoma met in Oklahoma City to thrash out the by-laws and the articles of incorporation for CATA. It was at this meeting that the group of founding fathers authorized the creation of CATJ, the CATA Newsletter (for members only) and a better definition of our goals and aspirations was set down on paper. It was at this time that many of the present elements of the "CATA family" were put in place; Celeste Rule became our office manager, Bob Cooper volunteered his "spare time" to create CATJ (Bob was still President of CADCO at the time) and even our part-time office person Janet Stone began work at CATA.

I have been President of CATA for far too long. I accepted the job initially because of two reasons: (1) I had started CATA and I did want to see it get off on the proper foundation which I felt most if not all operators I had talked with wanted from their new trade organization, and, (2) nobody else wanted the job! In the ensuing three and one half years CATA has grown to more than 600 member systems. CATJ has become one of if not **the** most respected and best-read (world wide) industry publication, and we have passed through numerous battles together. Copyright finally went through, although severely modified I believe by CATA's presence on the scene. Gridley came along. . .and while it is still alive, the goal it set out to accomplish (**no** regulation for small systems) is all but secure. Fines and forfeitures were beat back by a clutch hit in the ninth



inning. Small earth terminals, exposed and pushed by CATA, are now a reality. We are started on the re-write of a new Communications Act. . .and for the first time in five or six years I see and hear talk about new small system construction once again.

At the same time CATA has developed an excellent group of member-selected Directors. I've watched with both admiration and some awe as the last three semi-annual meetings of the Board of Directors has progressively improved meeting for meeting until the most recent meeting, held during CCOS-77, exhibited a tightly knit, smooth operating bunch of very dedicated people seriously interested and concerned for cable's future. Not everyone of these Directors was "willing" to serve on the Board when they first joined; many had to be talked or even coerced into giving up some of their time, energies and talent for the good of the industry. Thankfully that period is now well past; as my mind "circles the table" of those who sit and represent you, the system operator, I know well that now we have our future in good hands.

It has been no secret amongst the Board that I have wanted to step down, to see that someone else has the opportunity to serve and represent the nation's independent cable operators at the seemingly endless series of Washington meetings and industry gatherings. I came very close to insisting that the Board accept my will this past winter during our Des Moines meeting, but agreed to stay on as President when Directors Kee, Haimowitz and Edwards requested sufficient time to review the CATA by-laws and to insure that in my stepping down there would be an orderly transition of the leadership of CATA.

The July CCOS Board Meeting finalized that step. The By-Laws have been modified so that a new position of Chairman of the Board has been created; sort of a place where old or former Association Presidents go off to wind down before being allowed to return to the totally private life. The Board created the post and elevated me to it; while they also debated the nomination of a new President. Founding Director Ben Campbell, who headquarters in Dallas, Texas, was nominated by the Board to replace me as President. By the CATA by-laws each member system will have the opportunity to vote on the presidency position, and to create a field slate if they so wish, before the middle of September. Regardless of how it turns out, the new CATA President will assume office at CCOS-78 and I will begin my final year of wind down as Chairman of the Board. In the future CATA Presidents will serve a two year term; and they will continue to be elected by member systems on a one-system/one-vote procedure.

As I wind down my last year as President there are still many things I would like to see accomplished. For one, CATA needs better support in the middle-ranks of systems; systems in the 2,000 to 10,000 subscriber range, who feel uncomfortable and inadequately represented elsewhere should find CATA to their liking. For another, I would like to see a 'History of CATA' prepared, for publication in CATJ, so that the events that have shaped our lives and our industry during the first four years of CATA are not forgotten or distorted by time as we begin to forget how it really was. But most of all I would like the opportunity to personally thank each and every independent cable businessman who has helped create CATA and to keep it running. There is no way I can do this on a one for one basis of course; but the doormat is always open at my Cordell, Oklahoma home should you ever be in the vicinity. I am hardly ready to retire from either life or the cable business, but the rocking chair does look more appealing with each passing year!

During this year of orderly transition I urge every system operator to do his share to see that CATA continues to be a progressive, open-minded and down-to-earth cable businessman's trade association. We are truly alive and well from coast to coast and border to border; let's stay healthy and alert!

"CONGRATULATIONS BEN"—"thank you Kyle."

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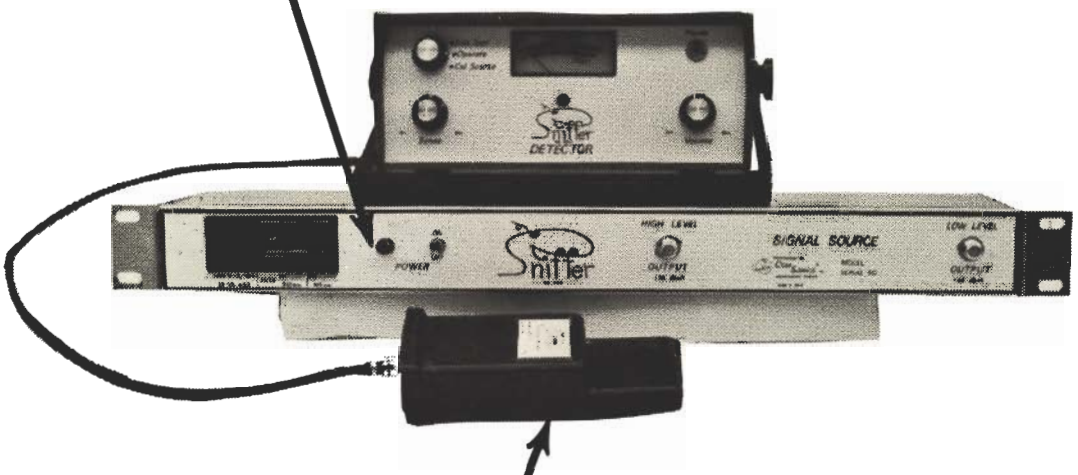

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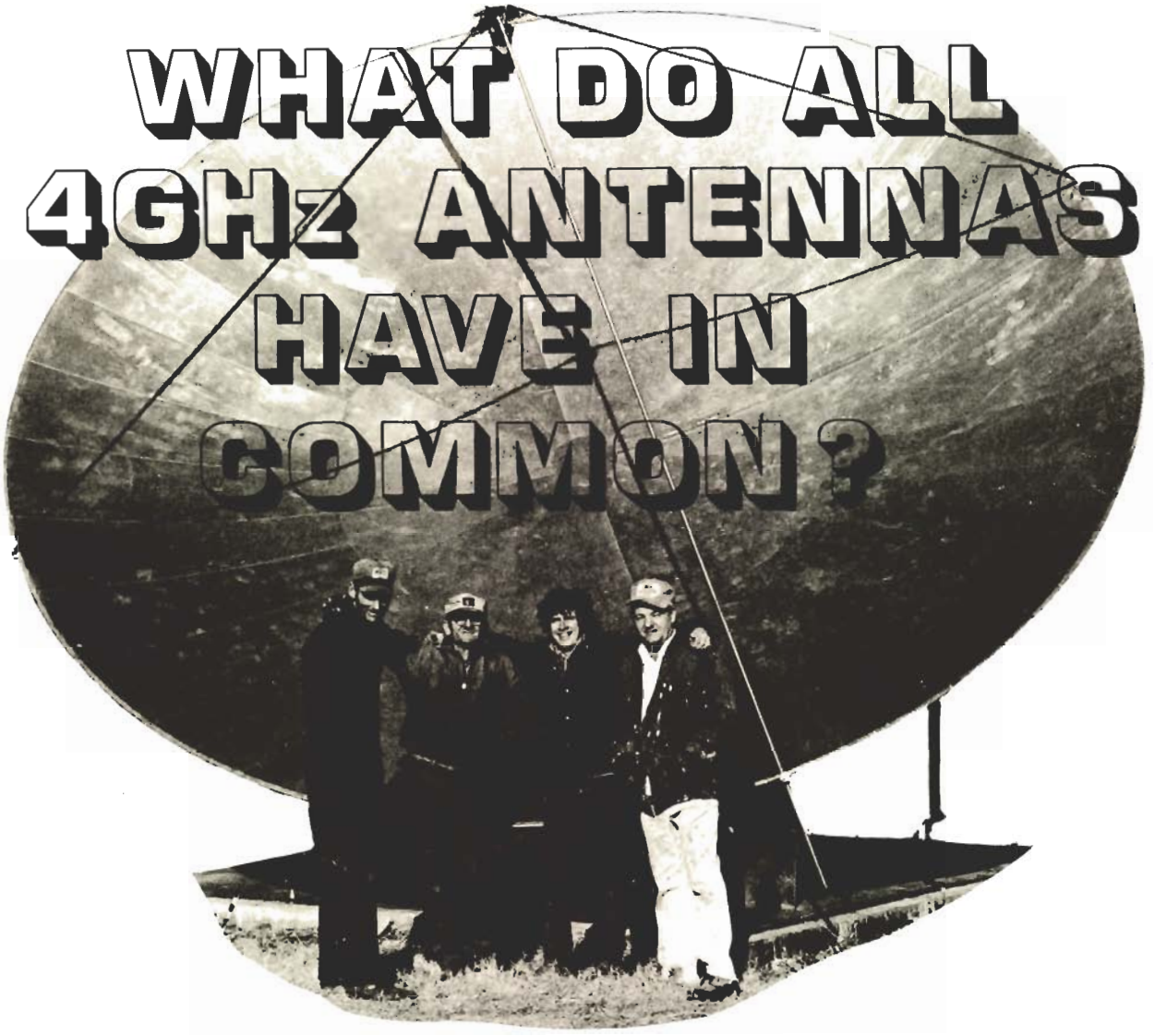

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As simple as C-COR'S two-year warranty is...

. . . it's caused quite a flood of questions and comments. We appreciate your interest, and we would like to show our appreciation by filling you in on some of the behind-the-scenes facts that allow us to offer this straightforward, but revolutionary warranty. (Competitors, take heed.)

THE SIMPLE FACTS

Q: Why has C-COR offered a two-year warranty?

A: To get your attention. Some people are skeptical that there is much difference in major manufacturers' equipment. There is a difference and we want to demonstrate that by our own faith in our equipment.

Q: Under what circumstances is the two-year warranty valid?

A: The two-year warranty applies to any C-COR manufactured product. It covers any quantity and any type of purchase from C-COR, be it a bill-of-material, turnkey, or Key Case.

Q: Isn't this going to cost C-COR a lot of money?

A: No. C-COR's warranty costs have been steadily decreasing. We are confident that our two-year warranty will cost us less than 50% additional over the low one-year warranty costs. This is a small price to pay for getting your attention.

THE BEHIND-THE-SCENES FACTS

Q: Why is C-COR equipment so reliable?

A: The major reasons for our outstanding reliability are:

1) Exceptional thermal design;
2) Total use of gold metallized and gold bonded solid state devices, transistors, and hybrids;
3) A rugged, reliable power supply, and
4) An exceptionally stable automatic level control system.

Q: How does thermal design affect the life of electronic equipment?

A: The chemical rate law says that for an increase of 10°C, the rate of chemical activity is doubled. Therefore, the life of any component in your equipment will be cut in half for each increase of approximately 10°C in operating temperature.

Q. What is so unique about C-COR's thermal design?

A: All of the RF devices and other solid state devices in C-COR's equipment are conductively coupled with the casting, which dissipates the heat to the outside atmosphere. In C-COR equipment, temperature rise is held below 13°C. No other manufacturer has temperature rises this low.

Q: What is this thing about gold devices?

A: A major RF device manufacturer has concluded that the mixture of gold and aluminum leads to metal migration and decreases reliability. It is C-COR's experience that when the manufacturer went to a total gold system of gold wires and gold metallization, the failure rate drastically decreased. Two major hybrid manufacturers now utilize a total gold system.

Q: How are C-COR's power supplies protected?

A: C-COR's famous surge protection module is supplied to the secondary of the power transformer to absorb, as an ac crowbar, overvoltages, power surges, and lightning pulses. In addition, all components are over rated to improve their life and reliability. The switching transistor and the control IC are protected by Zener diodes, and the entire power supply is protected by a dc crowbar shut-down circuitry.

Q: Why does C-COR use a switching mode power supply?

A: A switching mode power supply is much more efficient than a series regulated supply, especially when applied, as C-COR does, with a tapped transformer to further improve its efficiency. C-COR went to this supply since any heat that is not generated within the amplifier does not have to be dissipated. It is extremely quiet and more reliable. It saves on the power bill, too.

Q: What has automatic level control got to do with reliability?

A: If your automatic level control system works well, the amplifiers are set and then left alone. Leaving the equipment alone . . . keeping people's hands off of it . . . increases reliability. C-COR systems don't require adjustment, even on a summer-winter basis if the temperature differential does not exceed 130°F. Secondly, the automatic level control system itself, by the use of modulated pilots, is extremely reliable. Tricky, failure-prone dc amplifiers are avoided, and amplification of the 30 KHz modulation is done on a stable, reliable integrated circuit.

Q: Do external test points affect reliability?

A: Yes. Since the system technician can measure amplifier performance with the external test points, and even the ac power on a separate ac test point, there is no reason to disturb the integrity of the amplifier housing for routine checks and measurements.

Q: Is there any proof of the reliability of C-COR equipment?

A: Yes there is. Studies were made of six systems built and serviced by C-COR under our one-year warranty. In-the-field reliability was calculated to be in excess of 200,000 hours MTBF. This means that each piece of equipment will fail, on the average, once every 23 years. And we expect that the equipment being produced in our factory today will last even longer. Another "proof" of our reliability is that current C-COR customers are unimpressed with the two-year warranty. They already know how reliable the equipment is. We have had many reports of total "hands-off" operation of C-COR systems.

Q: What is C-COR's philosophy on model changes?

A: We believe that model changes should incorporate small, not drastic changes. This assumes that you have a good product to start with, of course. Our changes through all of our solid state life have been relatively minor so that we are able to retain the advantages of that which has proven to be reliable.

C-COR Electronics brings you 24 years of experience in the manufacture of amplifiers for cable television systems. With C-COR equipment, you are not only getting the technological superiority that comes from producing nearly 100,000 amplifiers; you now also get the peace of mind of a solid two-year warranty. We are able to offer you this because we do not have a corporate giant as a parent . . . we have no parent at all to tell us what to do. We are responsible only to you, our customer.

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CCOS-77 SETS SEVERAL RECORDS

"I'LL BE BACK. . .

. . .I've Never learned so much useful stuff in such a short period of time." So penned one CCOS-77 seminar attendee in the closing hours of this year's CATA Cable Operator's Seminar, held from July 17 through the 20th at Oklahoma's Fountainhead Lodge between Eufaula and Checotah, Oklahoma.

The final tabulation showed that CCOS-77 grew by 102% over the registrants on hand for CCOS-76; there were just slightly more than twice as many people on hand in 1977 as the first CCOS held in early August in 1976. And the size of the "crowd" (approximately 600 people all told) presented its own set of problems to CATA and the facility chosen for this year's gathering.

But the few problems presented by the non-metropolitan facility were apparently a more than satisfactory trade for the dozens if not hundreds of pluses for the state run lodge facility. But the hand writing **is** on the wall; CCOS has become **so popular** that it **has** outgrown at least the available facilities in rural Oklahoma. We'll come back to that point later on.

The CCOS-77 program schedule listed a total of 13 separate seminar sessions; four each on Monday and Wednesday (18th and 20th) and five on Tuesday. Sessions ran two abreast which meant that CATV people on hand were forced to pick and choose between those occuring concurrently. A session dealing with the "Future of CARS Band" was run twice simply because advance sign up for CCOS indicated that virtually everyone coming wanted to sit through that session.

AND SETS THE STAGE FOR NEW TECHNOLOGY FOR THE COMING YEAR

THE SITE—or a part of it. Looking north from Fountainhead Lodge through the parking lot; three 6 meter TVRO terminals brought in the multiple CATV service channels to both the display floor and (in the case of WTCG) through the lodge's MATV system to all rooms.

Honors for the "disaster of the year" went to a tantalum capacitor; the 300 MHz 'Mini-Freq' counter kits created by Steve Richey utilized five of the little beasties. The "count-out" exercise prior to the CCOS course had indicated (in a moment of panic to Richey) that the parts supplier had shipped only four per kit. A locally available substitute had been found but (alas) it turned out not to have sufficient voltage rating. When the first fast guy got to the point of firing up his counter for the smoke test an interesting sequence of events followed:

1) **The top end** of the tantalum literally **blew off** the capacitor, and the noise brought all 40 kit builders to their feet;
2) **Following which** a ring of fire appeared around the capacitor, in a complete circle, which burned in fashion similar to a fourth of July sparkler down the full "trunk" of the device;
3) **The flames,** going pretty good by now then jumped onto the board and billows of smoke followed as G-10 board and nearby parts blackened and scorched.

There were twenty five people in the kit building course assembling the 300 MHz frequency counter at that point, plus around 17 assembling the low cost spectrum analyzer. All 25 of the counter kits were then taken to that point of "fire up", and Steve Richey then piled them up for transport back to Oklahoma City where he spent the next week getting the units operating and into the mails back to the eager kit builders!

Inspite of this disaster the kit building course got generally high marks from the 42 who attended although as one fellow noted on his survey form "**. . .there MIGHT have been better preparation. . .**".

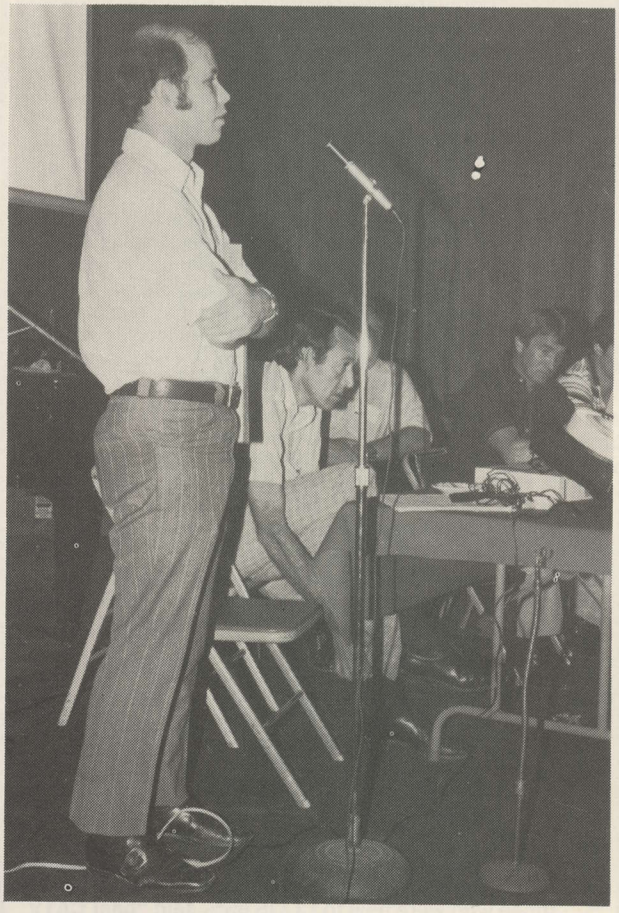
As with CCOS-76 we asked the participants to rate a number of things about this year's meeting utilizing a survey form that appeared in the rear of the program. We had an 18% return on the survey forms this year and we learned the following:

Top Three Seminar Sessions:

54% of those 'voting' indicated they found the 'Future of CARS Band' session a top session; 46% voting had similar feelings about the 'Off-Air-Antenna Systems' seminar, and, 39% felt the same way about the 'Rural System Construction' seminar. Other high rating sessions included 'TVRO's One Year Later' (32%) and 'Rural System Operation and Management' (29%). The top ranking hands-on test equipment session was 'Equipment Alignment Techniques' (18% found it the best session attended).

Other survey results appear here in 'box form'. It is worth noting, with some pride and gratitude we might add, that of those 'delegates' who were surveyed in 1977 and who also attended CCOS-76, 65% found CCOS-77 "Better than 1976" while only 12% remembered 1976 as being better. In

POKE THE LITTLE WIRE IN HERE—Barbara Herbert of GTE-Sylvania built a CCOS 'Low Cost Spectrum Analyzer' under the watchful eye of Steve Richey, shown here helping Barbara check out her circuit board.



TVRO PLANNING IS IMPORTANT—Dan Yost of Compucon (standing) provided plenty of installation tips on 'TVRO's One Year Later' panel chaired by Jerry Pell (playing with his shoe); Kevin Gossman of TelePrompTer in dark shirt to Jerry's left.

SIGN IN HERE—registration volunteers Jane Bockhahn (left) and Susan Cooper saw little of their busy husbands for five solid days so they busied themselves with handling some of the delegate registration chores.

CCOS-77 DELEGATE SURVEY

As is our custom with the CATA Cable Operator's Seminar, we ask the delegates on hand to complete a "reaction-survey" while they are still on premises; while the good points and the bad points are still fresh in their minds. Here is what that survey told us this year.

Location—93% felt the state lodge setting was a wise choice.

Seminar Sessions—96% liked the half day sessions per topic.

Most Popular—the six most "popular" sessions, in terms of delegate acceptance, were: **(1)** Future of CARS Band, **(2)** Off-Air-Antenna Systems, **(3)** Rural System Construction, **(4)** TVRO's One Year Later, **(5)** Rural System Operation, and **(6)** Equipment Alignment Techniques.

Most Unpopular—a surprisingly high number of those attending the Wednesday afternoon 'Headend Processors and Interference' seminar found the session to be "over their head". We have reviewed the tapes of the sessions and believe we know what **not** to do in 1978!

Location—92% responded favorably to the 'central USA' location for CCOS; and at least for 1978 it will be again repeated at a central location.

Display Hours—because of the 9 AM-12 noon and 1:30-5:30 PM seminar periods, the display hours for the exhibit room were in the evening. This generally got good marks (93% approved) but we intend to expand the available hours for the displays in 1978.

Size—delegates are apparently **not** sure **what** a good group **size** is; we had most of the CCOS-76 delegates 'comfortable' with the 1976 size group and this year 93% felt the 77 group size was either 'about right' or 'could have been bigger'. We were more than twice as big this year!

Lab Room—this year's Lab Room was either great (35%) or 'OK' (60%). But most people added **"It should have been open longer"** or **"Make it bigger".** We'll do one or both in 1978.

Swap 'N Sell—this was new this year; operators brought used gear, tagged it with their asking price, lodge room number and waited for calls. We counted around 120 pieces of equipment on the tables Sunday evening when CCOS opened but by the close of CCOS only 17 units were left unsold or untraded. We auctioned them off and gave the proceeds to the CATA Defense Fund (raising a big $72.00!). Everyone on the survey liked the concept and we will do it again.

Rating CCOS-77—of those who attended CCOS-76 (and CCOS 77) 65% felt this year was an improvement over 1976, 24% felt it was as good as 1976 and the remainder thought we had slipped backwards. Of those who were new to CCOS 65% said **"best CATV program I've ever attended",** 30% felt it was **"good but not the best"** while the remainder were split between **"fair"** and **"poor".**

the opposite area of those who were attending their first CCOS, 65% found the seminar "the best CATV program I've ever attended" and only 5% seemed unhappy with the event.

The Emphasis

Coming into CCOS-77 there was little doubt that the new low cost Gunnplexer/Microplexer microwave equipment recently intoduced by Microwave Associates was headed for the top of the charts. Advance sign ups had indicated that virtually everyone wanted to attend this session so it was scheduled to run at two separate times. The first session, in the afternoon of July 18th, saw over 260 attending and the repeat performance on Wednesday the 20th played to another almost full room.

There were two complete and separate operating low-cost microwave terminals on hand for CCOS. It is well to establish for the record that **one** is readily useable in the CATV arena; the second **is restricted** to **non**-commercial (i.e. amateur) applications.

The non-commercial version was first shown to operators during CATA's Board of Directors meeting on July 16th. The small packages mount on inexpensive and light-weight camera tripods and as shown here have provided noise-free video (plus audio) communications on a point-to-point basis over line of sight paths in excess of 2.5 miles. The amateur versions were constructed as a part of the on-going CATJ Lab developmental work in this area and they represent the current state of the "do-it-yourself" art in this field. Subsequent to CCOS, utilizing four foot parabolic antennas, line of sight paths out to 12 miles have been covered with the 18 milliwatt units. Ultimately, before the summer is over, the non-commercial versions will be operating (we hope) over paths of around 20 miles with video and audio. Again for the record, **these** are the very low cost packages; aside from developmental labor we have less than $250.00 in the two stations (one transmit and one receive). You go into the transmit end with video or video/audio (composite) and you come out of the receive end with video or video/audio (composite). Whenever the two units appeared on the seminar floor they quickly attracted a crowd of curious operators. They were demonstrated with an UPI color video feed as a video source during the course of CCOS-77's Rural System Construction seminar. The **non**-commercial version demonstrated **lacked one major refinement** found in the commercial (Microwave Associates) version; AFC or automatic frequency control.

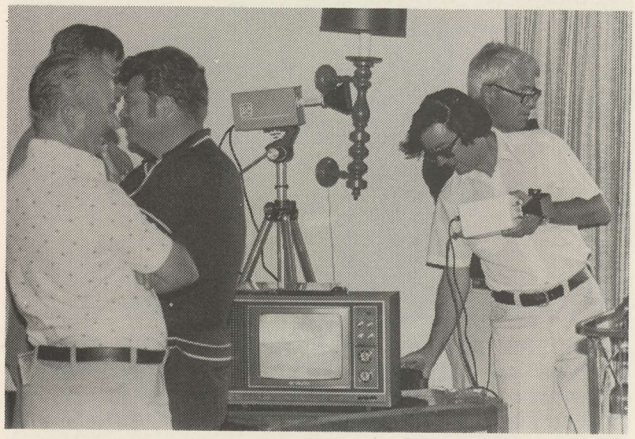
The commercial Microwave Associates version received very widespread acceptance during the course of the Seminar and was really put through its paces for various short haul applications in the real world. For example, M/A Chairman of The Board Dana Atchley demonstrated the system during the July 18th seminar by setting up a color camera at the

transmitter site and shooting the 50 milliwatt signal through the Fountainhead Lodge building. Nobody took the time to calculate the attenuation one might find going through glass, brick and mortar walls but the receiver and transmitter were hardly line of sight to one another (although the range was close; around 500 feet). The small units were outfitted with the same 17 dB gain horn antennas as the non-commercial versions and it was very impressive to see how on the commercial version one could spin the receive antenna off to the side or even the full rear **and still have** noise free pictures. The margin of signal available was obviously very high; far beyond that necessary to maintain a successful video link between the two points, even if it did go through a fair hunk of the Fountainhead lodge building and walls.

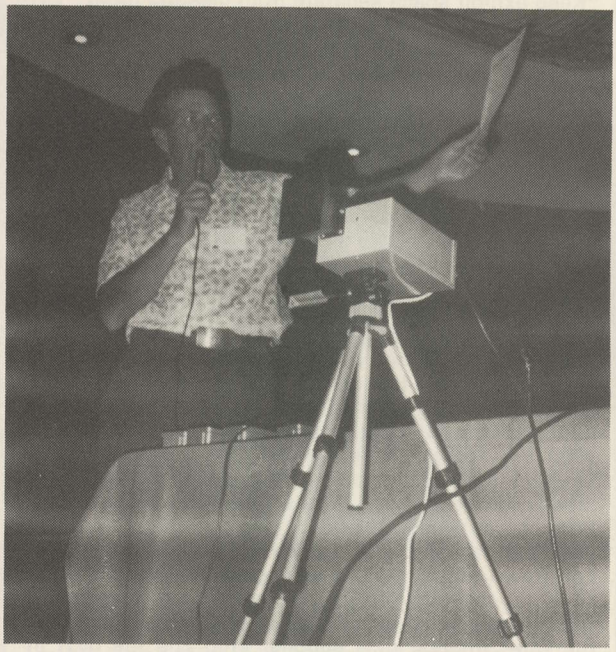
Several operating parameters involving the **commercial** version units became apparent during the course of the seminar sessions:

1) **A fairly high number** (60 plus) of existing CARS band users will be installing, as soon as the gear is ready for shipment in September or October, the receiver unit. Existing CARS band systems have quickly discovered that the low cost receiver ($1,550 per channel) allows them to **expand** the usefulness of their **existing** CARS band systems to numerous new smaller communities where previously available receivers made CARS band linking cost prohibitive.
2) **The units** will initially be available with an **indoor** housing **only;** unless the system operator can develop his own method of weatherproofing the transmit or receive packages, the respective units need to mount inside of the building.
3) **There is no reason** why passive reflectors, **if** suitable with the FCC, cannot be utilized with the systems; although the relatively low power of the units will work against long paths utilizing this "flyswatter" technique.
4) **Multiple units** (at least up to 12) can **share** the **same** transmit or receive antenna, and waveguide (feedline) if that is desireable.

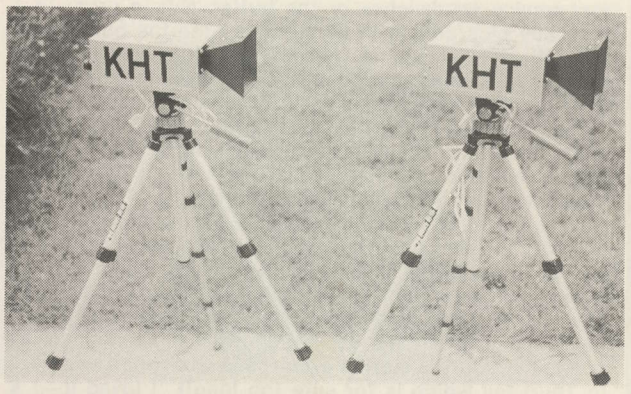
System operators should keep in mind that this is a 'video-in' and 'video-out' format; this means that to drive or feed a Gunnplexer/Microplexer microwave system you need a commercial CATV demodulator to derive the composite video/audio feed to modulate the transmitter. This also means that if you are located at the receive end you need a commercial CATV (channel) modulator to put the video format or composite signal back onto the cable system. This is an FM (**not AM**) system and for multiple channel packages the Hughes AML system is still the only available 'RF-in/RF-out' package on the market. There apparently **has been** some experimentation with RF-in and out utilizing the Gunn diode transmitter and receiver units but to date it has not been successful enough to warrant serious commercial consideration.



IS THAT ALL THERE IS TO THAT? 'Preview' demonstration of Microplexer microwave in lobby shows M/A Chief Engineer Fred Collins (Gunnplexer unit in hand) 'establishing contact' with duplex audio unit on 10.3 GHz amateur band while commercial receiver (behind TV set) receives 12 GHz color transmission from camera/transmitter outside of lodge.



OLIVER SWAN and his antenna data sheet, with the low-cost Gunnplexer microwave receiver package in the foreground. Swan asked "Will CCOS offer a Gunnplexer modulator/demodulator kit session in 1978?" We might.



THIS IS AMATEUR—not commercial gear! Delegates saw the operating 10.3 GHz amateur version of the Gunnplexer units, developed by Steve Richey and Bob Cooper and operated under the latter's W5KHT amateur license.

BUILD A RELIABLE MICROWAVE SYSTEM!—was the panel message from Jim Hurd (left/Farinon Electric) which ran as a part of the 'Future of CARS Band' session held on two separate occasions during CCOS.

CCOS-77 SOAP BOX

Delegates to CCOS-77 were asked to comment on their impressions of the 1977 gathering. Not every comment can be printed because of space limitations, but here is a random sampling of those received.

"Keep exhibit space separate from meeting room". **(We concur with the concept; unfortunately when you are short of room period you sometimes have to double up. If we find ourselves in the same spot again, we'll attempt to police the noise in the exhibit hall better to keep distractions down.)** "Kit building should be a longer session". **(Or the kits should be less complicated and require less time to build!)** "Outdoor antenna sessions should be longer" **(What we really need is a room where Oliver Swan and Tony Bickel can headquarter for the full session and simply let people go to them with their antenna problems.)** "My wife enjoyed the style show and the women's activities". "Enjoyed every moment—appreciated your having things for the children to do." "Blazing Saddles should be shown at every CCOS!" **(Blonder Tongue ran two movies on channel 3 back to back throughout the convention, and loaned out descramblers to operators to take to their rooms for the two features. Strange how nobody even remembers what the second feature with Blazing Saddles was!)** "Exhibit hall was not open enough". **(Agreed. We'll modify that next year.)** "There were not adequate numbers of Lab Room set ups". **(We had 50% more this year than last and still had a full house. We'll expand Lab Room hours and set ups again next year!)** "Some sections of the seminars were more for manufacturers than operators". **(That's a hard call to make. Where does the sales interest of a supplier stop and the best interests of the user begin? We don't know but we think overall the balance was more than adequate.)** "Did not care for the lodge's buffet style food service". **(Roast beef three days in a row got to us also. Next year we'll see that at least for lunch you have a choice between fast-service sandwiches or the buffet. But in order to feed 600 plus people in 90 minutes time the buffet or cafeteria format seems the only sensible way to go. Handling 600 custom food orders with traditional waiter service would have been a disaster!)** "Some time should be set aside for CATA Directors to meet with operators from their districts." **(Wish we knew whether this came from a member or a Director! In any event it is a good suggestion and we'll figure something out.)** "Try to find an area that is either not quite so hot or change the time of year." **(It was hot. But the air conditioning worked great!)** "How about a seminar on simple,.small town marketing techniques?" **(Good idea...who want's to volunter to work on this one?)** "Keep it up...Sunday to Wednesday is just the right length!" **(Unless you are on the CATA/CATJ staff in which case it becomes Friday to Thursday which is for sure too long!)** "I loved it—I learned a great deal and had a fine time with my family."

(And that friends is the bottom line!!!)

On the bottom line there appeared to be several hopeful signs as to the future of Gunn diodes in the CATV microwave arena. **Number one** - M/A's Dana Atchley said he 'worships' a volume production curve wherein as the volume goes up the cost per unit comes down; **way down.** He explained how his company has produced more than a half million Gunn diode devices, and said he foresaw operating packages similar to the Gunn plexers **eventually** dropping down into the $1,000 range (**complete with all** operating accessory electronics) at some future point in time...**if** the volume takes off. **Number two**—it appears that while the present format calls for video in and out (thereby creating the need for a demodulator to create the video feed at the transmitter and a modulator to re-create the RF feed for the cable system at the receiver) the "possibility" that there will be an RF-in and RF-out format at some future time seems quite good. **It is** beyond present technology to create this type of format at this time, but technology has a way of catching up with the need. Even if the price was the same as the present video in/out format, **if** the cable operator could **eliminate** the additional demodulator and modulator 'boxes' he would be money ahead and the flexibility of the system would be considerably improved. **Number three**—the present 50 milliwatt transmitter level is strictly a function of Gunn diode selection. There are Gunn diodes that offer output powers up to nearly 1 watt at 12 GHz; but they are expensive at this time because their volume is very low. The price-effectiveness of the present 20-50 milliwatt Gunn diodes is largely due to their volume appearance in the police radar market; if police radars should start to utilize the higher power Gunn's in volume the price of the diodes will come down in the higher power versions. **Number four**—useful communications range is still best created by the careful selection of antennas and antenna feeds. If the small 17 dB gain horn antenna is not adequate (it seldom will be except for very close hauls of under 3-5 miles) one can go from 17 dB to 36 dB gain of antenna with a simple change out to a 2 foot dish. Or a four foot dish will produce 42 dB of gain. If you replace two 17 dB gain horn antennas (34 dB of total antenna gain) with two 42 dB gain four foot dishes, you have added 50 dB of "path gain" to the system. On the other hand a power change from 50 milliwatts to 100 milliwatts is only going to add 3 dB of path level-gain to the system. The antenna is obviously the way to go.

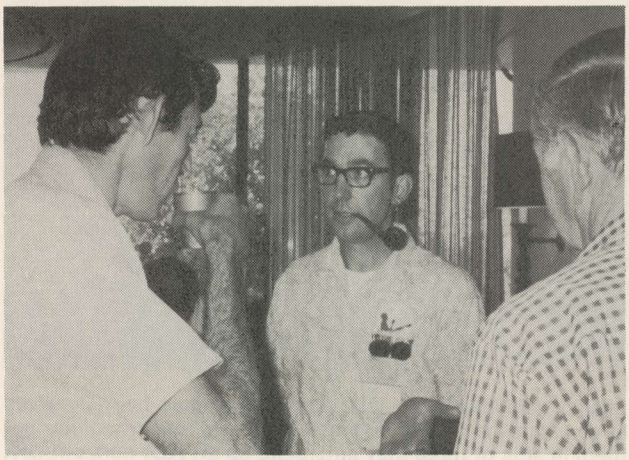
For many of the CATV system operators in attendance, this was their first exposure to microwave of any type. There was volume interest in the package and if the supply can keep up with the demand through 1977 and the first half of 1978, it would appear that by CCOS-78 a substantial part of the seminar delegates will be reporting back their own first hand experience with the new low cost microwave equipment.

If the low cost microwave was the stellar piece of technology on hand, a gent from Bisbee, Arizona was the hands down winner for attracting the highest number of accolades. **Oliver Swan,** featured extensively in the March 1977 issue of CATJ, brought his own brand of CATV rural technology to the CCOS gathering. Swan joined forces with the always popular Tony Bickel of USTC to put on a Tuesday morning session devoted to "The Care and Feeding of Off-Air CATV Antenna Systems". The 'crowd' spread out under the elm trees and Bickel and Swan got right into antenna systems, phasing and matching tricks, stacking procedures and gain and pattern tests. CATA/CATJ video taped the bulk of this presentation, and is now creating a twenty minute color video cassette (3/4 inch format) for rental to CATV systems. We'll have more to say about this new 'Video Tape Library Service' in the September issue of CATJ. The crowd numbered more than 150 as Bickel used a special test tower rigged for CCOS to demonstrate what happens when antennas are stacked for co-channel elimination, and how other nearby non-interconnected antennas can de-tune stacked arrays by their mere presence in the field of the desired array. Oliver Swan's long-long 'Logi' antennas attracted plenty of interest and most in attendance were amazed at Swan's ability to create cable-useable signals with inputs as low as -35/40 dBmV over paths up to 200 miles in length. Swan's **"You can do it far cheaper if you do it yourself"** approach caught the fancy of many rural system operators who found his words encouraging. Swan reported he had just completed a new 'system' of 2.5 miles length with 125 connected homes the week prior to CCOS. **"It will pay back the full investment in around ten months time"** noted Swan; he may have half of rural Arizona and New Mexico cabled before he gets done.

Swan also sat with Steve Richey during the Wednesday session entitled "Rural System Construction Techniques" and there Oliver explained why he had chosen to build everything but the cable for his own 'mini' rural systems. We noted that prior to the session many operators were envious of Oliver Swan's obvious talents with a handful of parts and a soldering iron; we also noted that after the session some of these people who professed that they had never been much for building gear were stashed away with Oliver in the CCOS Lab Room constructing line amplifiers of Swan's design (see CATJ for March). Swan brought with him a boxfull of component parts and he spent plenty of time with the Lab Room group in the evenings seeing to it that anyone who wanted to sit down and construct their own pre-amplifiers, bandpass filters, line amplifiers or whatever got the opportunity to do so.

"I guess I never really realized how much money a small operator can save by building some of his own gear" noted one operator from Florida. **"I have always been afraid of doing**

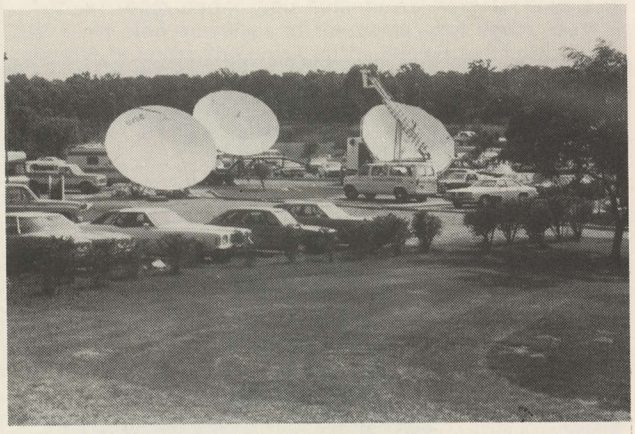
IF YOU CAN'T SWEEP IT—it's not real! During 'System Sweeping Techniques' seminar ably conducted by Wavetek's Bob Welsh (center) operators broke up into groups to operate sweep and display equipment. Welsh's boat set a new 'CCOS Record' for simultaneous water skiiers 'up' this year; six. Going for 8 in 78 Bob?



THIS IS A THREE PIPE DAY—CATJ Editor In Chief Bob Cooper (center) needles Jerry Pell (left) about 'losing his beer-drinking image' while ITT's Don Buscher (right) looks on. (Yes—Don does have a face, but for two years running it has eluded us!)

KITS GALORE—the kit building class had two separate operations going at same time; construction of 300 MHz Richey 'Mini-Freq' counter plus Laufer/CATJ 'Low Cost Spectrum Analyzer'.

BY-LAW CHANGES—intense study of CATA's By-Laws followed six month-long study and recommendations from By-Law Committee headed by District Seven Director Chuck Kee (left). In middle Director Mickey Gahan (California) and 'Big Ralph' Haimowitz (District Four), right.



SMALL TERMINALS?—six meters may only be 1.5 meters larger than the CCOS-76 'small terminals' but when you get them in sets of three they sure gang up on your horizon! Left to right, USTC's terminal, RF Systems terminal and RMI terminal. All worked to perfection.

WALL TO WALL TEXSCAN—plus Raleigh B. Stelle, III added up to one very popular session dealing with equipment alignment procedures. Session included hands-on application of test and alignment procedures.

much more than putting on fittings previously; but I think spending several hours with Oliver Swan got me over that mental hurdle. The man is not only a genious, he is patient with a beginner". Not just the hands-off crowd were impressed with Swan. Gene Edwards, CATA District Director from Ohio, a man who knows his way around a soldering iron and who has been in the CATV business some twenty five years noted **"I just spent the most fascinating 30 minutes of my entire CATV history. . .with Oliver Swan. That 30 minutes more than paid my costs of coming to CCOS."**

Yes Oliver Swan fans, Oliver is being invited back to CCOS-78!

The Change

The 'big news' at CCOS-**76** was without question the on-hand demonstration of two operating 4.5 meter (so-called small) TVRO receive terminals. As everyone knows well, CCOS-76 provided an open forum from which industry support for small terminals built through the balance of the summer of '76 and throughout the fall of last year. Then last December the FCC approved the use of the less-than-9-meter CATV earth terminals.

In 'TVRO's One Year Later' panel moderator/-coordinator Jerry Pell assembled a long list of participants who represented two different views of where we are with the TVRO 'revolution'. The first segment of the discussion was devoted to the 'real world experiences, successes and failures' of TVRO installations (both 10 meter and the smaller 4.5/6 meter jobs) to date. The second segment included representatives from HBO, Southern Satellite Systems (the common carrier that provides WTCG-17 relay) and RCA (the SATCOM owner).

The big 'news' was largely in one or more rumor forms during CCOS. **Rumor one**—that Southern Satellite was **about** to announce the availability of a new (second) independent (non-network) signal via SATCOM. **That one turned out to be true;** SSS has announced that beginning on or before August 1, 19**78** (that's one year away give or take a few weeks) the San Francisco / Oakland independent **KTVU** (channel 2) will be available off the bird. The KTVU bird-relay will provide systems with **two** indies via satellite; one in the eastern and one in the western time zones. SSS says that they will start service on August 1, 1978 **or before if** they are able to sign up 500,000 cable homes for the service prior to that date. KTVU was, you may recall, the 'most likely prospect' for satellite relay in our extensive CATJ coverage of earth terminals in the February, 1977 issue (see pages 30-34 for discussion of the KTVU fortunes via the bird). **Rumor two**—that there were several new 'lower priced' receivers about to come on the market. This one also turned out to be true. **Microdyne** finally admitted that they had a $4,000 "range" receiver which when available late this fall will be single channel, fixed tuned. The unit

will be available in two slightly different formats; in the least expensive version the channel is 'dedicated' at the factory and to change the receive channel requires either plenty of test equipment and smarts, or alternately (and adviseably) a trip back to Microdyne for the hardware. In the slightly more money version (a price differential of around $350) the unit can be field-changed for input channel by swapping out a crystal and making some minor user adjustments. Then **Microwave Associates** had a similar announcement to make; an "under $4,000 receiver" also fixed tuned, single channel, also available in the non-field changeable and the field changeable formats. It too will be a late fall delivery package. **Rumor three**—involved the general pricing structure of TVRO terminals. Many in the industry have been forecasting that "someday, somehow, some way" the price for all of the major component hardware items in a TVRO installation (i.e. the gear, less the installation) "would drop to under $15,000". CCOS delegates were apparently looking for bargains in TVRO installations, and numerous we talked to said they were ready to buy one or more terminals "on the spot" if the price got "right". By Tuesday the 19th the price apparently got right; approximately 30 operators met in a lodge meeting room and tallied up how many terminals "the group" would buy, as a minimum, if the price got down low enough. This ad hoc group of operators heard a presentation from a representative of the Christian Broadcasting Network (CBN) who told them that **his** group **could purchase** TVRO equipment (dishes, receivers, LNA's) for something called "OEM Pricing"; or original equipment manufacturer pricing. When the smoke had cleared they had formed a steering committee to investigate the possibility that they could effect considerable savings by purchasing together as a group, possibly through the CBN offered 'OEM pricing schedule'. In preparing a talley of 'pledged interest' we counted 37 separate terminals (4.5 to 6 meter in size) totaling around 100 separate receivers (!). The pricing, with the 4.5 meter antenna, medium grade GaAs-FET LNA and a single channel receiver was definently under the $15,000 number which some had set as their "buying-interest" point. That $15,000 number sure looked awfully good to the operators who during CCOS-76 were facing $80,000 to $100,000 range numbers for ten meter terminals. **Rumor four**—had it that the number of transponders in service, of interest to CATV system operators, was about to increase. RCA SATCOM representative Al Parinello tried to set the record straight. At the present time we have the following "CATV dedicated" transponders in use: transponder six which carries WTCG from Atlanta; transponder eight which carries the CBN feed sixteen hours per day from Virginia; transponder 20 which carries the HBO west coast (time delayed from east coast) feed; transponder 22 which is 'HBO reserved'; and transponder 24 which is the HBO east coast feed.

THE SUPPLIERS WANT TO DO WHAT! The lady who makes it all come together every year at CCOS and everyday at CATA/CATJ, Celeste Rule, during a CATA Board meeting session discussing the supplier relationship with CCOS.

It appears, if the legal hassles can be cleared, that the CBN feed on transponder eight is going to go to a twenty four hour per day format sometime in the near future. What is of interest to the cable operators is that when CBN goes twenty-four hours per day only 40% of their programming 'day' will be slanted towards their basic religious background. The remaining 60% (or 14.4 hours) will be something they call 'family viewing', largely made up of off-network situation comedies (**Leave It To Beaver,** etc.), one movie per day and some sporting events (such as football). The hang-up at the moment seems to be how the CATV systems shall be 'charged' for the 24 hour format. CBN is ready, willing and able to pay for the 40% of the programming day which they will devote to religion; but there are forces at work which insist that the cable operators should pay (ala the ten cents for the full day arrangement per month for WTCG) for the balance of the day. This is untested and new 'legal ground' for the FCC and the various entities involved and while it is hoped that it works out quickly there is always the possibility

THE CROWD—or a part of it. Sessions tended to be better attended (more than 250 in more popular sessions) but most delegates reported they still felt comfortable with 'group size' and opportunity to ask questions of seminar session leaders.

that it will not be so quick.

Waiting in the wings are at least two more religious based service firms; the PTL (club) group which plans to provide only religious broadcasting via satellite was the most talked about group and they seem headed for some type of 1977 start date with satellite programming.

Other interesting tid bits that came out of the TVRO sessions (plus the on-site TVRO demonstrations by **RMI, RF Systems** and **United States Tower Company**) included the fact that a Mexican based group is now utilizing the bird around 8 hours per day to distribute Spanish language programming to affiliates; that NBC is now up to around 8 hours per day for the relay of programs from coast to coast (getting an early feed of the Tonight Show is fascinating but definitely not legal for a CATV system to carry!); and, that CBS is close to doing the same thing 'probably this fall'. There was some concern that all of the twenty four transponders on SATCOM II would soon be used up. The evidence suggests it **may** well be **crowded** by this time next year, but that there are still plenty left (transponders 1 through 5 are dedicated to uses other than video, such as high speed data).

On the practical side the sage report of Compucon's Dan Yost pretty well said it all.

> **"Eighty percent of all CATV headend sites we have completed site surveys for can be utilized for TVRO installations,** including small antenna installations, although some are going to be required to create some shielding to prevent them from receiving terrestrial interference on one or more of the TVRO channels".
>
> "**The FCC requires that the CATV system clear every transponder in advance;** that means that a proposed TVRO site must be able to receive (on paper) all transponders without terrestrial interference."

"**The proposed TVRO site must have see-through visibility over the complete satellite arc,** from 70 degrees to 135.8 degrees west longitude. If the site chosen will not allow the operator to swing his antenna through that complete arc and have not-shielded visible access to the spot in the sky where the satellites are parked, the FCC will not approve the site chosen. You cannot look through a tower, building, etc. at any point along this arc."

TerraCom's Bob Boullio noted:

"**TVRO's should take the conservative approach.** The satellite life is expected to be from seven to ten years. During that period of time the fuel on board to maintain the position of the satellite package runs down. When the bird can no longer achieve and maintain its proper 'fixed' position it will no longer be useful to terrestrial locations. And during that period of time we can expect the equipment on board to degrade somewhat, resulting in lower EIRP (i.e. signal) levels over the full 'footprint' of the transponder. The CATV system operator needs to have some margin of safety built into his receiver system for not only short term signal level changes (due to faraday rotation, rain attenuation, etc.) but also to compensate for satellite efficiency changes."

Worldwide there are presently 22 communication satellites in orbit (not including non-commercial or military units); twenty more in the developmental stage (i.e. actually under construction) and 10 more in the planning stage. The present state-of-the-art dictates that each transponder on each bird has a slightly different "footprint" or "EIRP" level. For example, in central Florida the level of signal from CBN's transponder 8 is around 2 dB higher than the level of signal from WTCG's channel 6 transponder. This 2 dB makes one heck of a difference when a system is coping with the difference between say a 4.5 and a 6 meter antenna (also about 2 dB difference).

Other worthwhile tidbits gleaned from the well attended TVRO session:

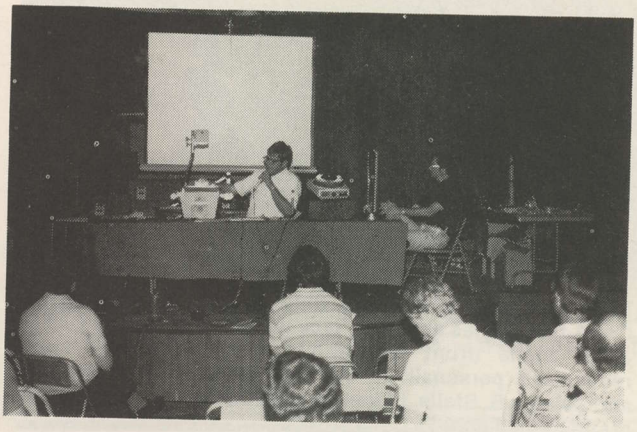
1) **You have about a 50-50 chance** of losing your LNA to bad weather or power surges during the first year. The total "device" is not shot following such an outage, but there is a several hundred dollar bill involved in getting it back operating again.
2) **Having back up LNA capability** is a good idea. . .but putting the spare up **on the dish** is perhaps **not** so good an idea. If the outage is caused by lightning, the strike will probably get **both** units. It takes 15 to 20 minutes work time to replace the LNA, and it seems smart—to store it "dry" rather than putting it on the dish where it can get zapped.
3) **Many systems are stocking** a second higher noise temperature "spare" LNA, for standby purposes. For example, if your regular LNA is a 120 degrees kelvin unit, having a 150 or 180 degree unit on hand as a spare ties up less money than a duplicate unit, and it provides usually adequate service for the interim period while your main unit is off getting repaired.

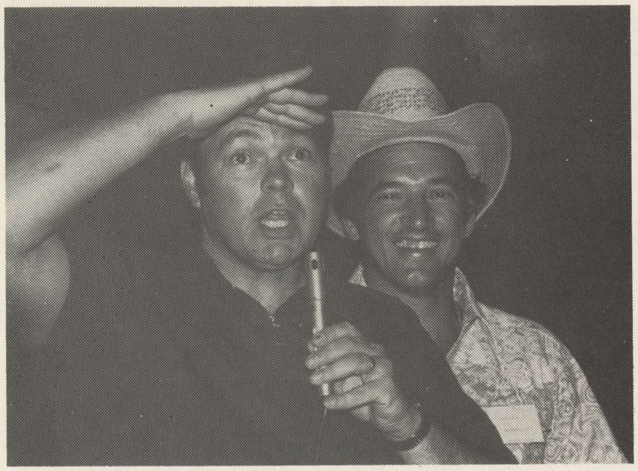
When you have long cable span distances between the TVRO antenna and the headend shack (due to special site considerations for the TVRO), the best choice is to down convert to the 70 MHz IF **at the dish,** then carry the IF signal through coax to the CATV headend where the demodulator portion of the receiver is located. You can't afford to run (for example) 1,000 feet of 7/8ths inch line for the direct 3.7-4.2 GHz feed, and if you demodulate to video (4.5 MHz) and audio (0-15 kHz) and try to trunk these low frequency signals into the headend you often find local AM radio stations and other low frequency program sources get into the demodulated feed being trunked into the building.

5) **The first CATV system** in the country to employ **two separate** TVRO installations is Owensboro, Kentucky. Because of the special requirements of the Owensboro sys-

ONE MORE IC AND I FLIP!—Construction of 300 MHz 'Mini-Freq' counter 'flipped' the builders but a bum tantalum capacitor 'flopped'.

SERIOUS MICROWAVE STUFF—on stage, John Schuble (left) and Bill Ellis (right) from Telesis in Evansville, Indiana provided hard to find top level microwave system planning and application advice in popular four hour session.





YOU GOTTA WATCH FOR INDIANS!!! Ralph Haimowitz of Sebastian, Florida educates NCTA Prexy Bob Schmidt on how to survive in the west. Tenderfoot Schmidt lost his hat shortly thereafter.

THE FAMOUS 'HAT'—of CATA Director Pete Athanas (Lake Geneva, Wisconsin) watches the CCOS-77 Talent Show along with Scientific Communications LNA man Tom Humphries; Athanas is the only 'Greek-Indian' in the world.

TALENT/TALENT/TALENT—they called themselves the CATA-tastrophies and for a 'pick up' group including CATA's Janet Stone (front left) and family, plus other easily-recognized 'personalities' such as Jim Emerson (back, left) and Raleigh B. Stelle, III (center with the hat). . .they sounded pretty darned good!

tem, signals from two different satellites are being employed. The Kentucky system recently completed installation of its second terminal.

6) **It was obvious** that serious research needs to be done on the manner in which TVRO installations are grounded. The concensus seemed to be that "sheath currents" (see **CATJ** for February 1975) are the major culprits and getting the TVRO antenna, the receiver and the LNA at the same DC potential was the best goal for an installer wishing to avoid losing LNA's at a periodic clip.

7) **Snow piling up** on the feed of the TVRO antenna does not seem to be a **bad** problem (possibly because the surface area for the build-up is very small, and the build-up is minimal if there is any wind); however when the lower lip of the dish does get wet snow build-up the dish changes its **focusing** characteristics. This has been noted to cause outage of satellite signals until somebody went out and "swept" or "shoveled" the wet snow from the dish. **Can you heat the dish?** Yes. . .but it costs lots of bucks, requires gobs of electricity and is generally not recommended. Can you heat just part of the dish, say the lower lip? **No.** That will cause stresses on the dish surface, deform the dish and then you have got problems in River City!

8) **What ever happened** to the **AFC horn antennas?** They are still around, and are being sold. The horn antenna has excellent side lobe control, and a very low noise temperature. They are primarily being utilized, in the 14 foot size, in areas where dishes (which cost less) cannot make the required FCC frequency coordination. Dan Yost estimates that between 1 and 5% of the applications now being studied will end up using horn antennas simply because the extra cost of the horn will ultimately be a lower expense than selecting a far-away (from the headend) TVRO site.

9) **How close** has a TVRO terminal been placed to an existing **terrestrial** microwave station in the same 3.7-4.2 band? About 9 tenths of a mile. **"But"** as Yost notes **"it really depends on the direction-of-fire of the terrestrial station, and whether the TVRO has to look over, through or along side the terrestrial station".**

10) **Some sections of the country** have experienced some difficulties with local environmental protection groups protesting the installation of a TVRO antenna in certain areas. Kevin Gossman of TelePrompTer suggested that the best solution to this problem is to **1)** get a good attorney based in the area involved, **2)** work with the antenna manufacturer to select some form of antenna installation that is most pleasing to the aesthetic values of the area (short of

burying the antenna underground!), **3)** be ready to 'paint' the antenna and support structure some color which is 'pleasing' if not satisfactory to the local objectors. Another problem Gossman reported is small rural airports which have a twenty foot height protection zone around them, In two TPT locations the dishes were all of 1.5 feet **over** the twenty foot maximum height allowed; the solution was to "excavate" the ground slightly to bring the top the dish installation down under the 20 foot maximum allowed.

All in all the past year, from the premature CCOS-76 demonstrations of 4.5 meter feasibility to our present day operational status with the smaller sized terminals, has been one of the most exciting years in the industry. The cool, business like and realistic presentations by those who have become proficient in earth terminal installations and operations and the programmers who are now filling more and more transponders with CATV type program material indicates that when again we address the subject at CCOS-78 the TVRO topic will have moved full circle. In 1976 it was speculation. In 1977 it is current technology. By CCOS-78 it will probably be old hat and the fast moving CATV industry will be looking for new worlds to conquer.

Not All Work

CATV operators, engineers and technicians traveled to CCOS-77 from 42 states, Canada and Mexico. From Maine, and Hawaii and points between they came to not only learn and soak up the leading edge of new technology, they also came to enjoy themselves with their families. A CCOS sponsored Monday morning brunch saw 96 wives enrolled in this "Ladies' Seminar". Other women's events saw upwards of 50 women gathering for this trip or that event. But the big event, for all who had traveled to Oklahoma (including the wives and children) was the now annual CCOS Bar-B-Que. This is traditionally held on Tuesday evening of the gathering, preceded by a cocktail-half-hour on the lawn adjacent to the lodge. Only this year was to be different. Who recalls how it got started. . .it simply did. A "talent" show was to follow the Bar-B-Que. Fortunately, perhaps, the 'CCOS-77 Survey' did not ask the question 'what did you think of the talent show?'!

The initial concept was that somewhere out there in CATV land there was 'talent'. People (operators, wives, children) who were capable of entertaining. Or being entertaining. Now the attendance this year was larger than last year; people who wouldn't have been caught at a CATA gathering appeared in substantial quantity this year. Among those gracing us with their presence was NCTA President Bob Schmidt who appeared outfitted for the climate and locale. He wore an easterner's version of a "cowboy" hat. Which naturally set him off from the rest of the 'cowboys' in the crowd.

To kick off the 'talent show' CATA Director Ralph Haimowitz and CATA's Celest Rule had 'arranged' for an Indian 'attack'; assisted by some native Oklahomans. Just ahead of the 'attack' Haimowitz spotted Schmidt in the crowd (he was the only one wearing a 'cowboy hat') and brought him to the stage area. There Haimowitz introduced Schmidt and then 'warned' him of the 'importance of keeping a wary eye peeled for Indians' in Oklahoma. That was supposed to be the 'cue' for the Indian 'band' to swoop down on the group from an adjacent hilltop and 'mannap' Schmidt. Only someplace between the planning and the event the 'Indians' forgot their horses, and rather than a band of a half dozen husky braves the cue brought a family of native Oklahoma Indians including several children and women folk. Schmidt (who had no fore knowledge of the 'plan') was a good sport and when the Indian group finally made it down the hill through the crowd to Schmidt he didn't resist the good natured attack on his person.

The talent show then took off with many familiar-to-CATV faces, voices and sounds. Whether CCOS holds a talent show again in 1978 is conjecture at this point. It was a good effort by those who worked hard and long on the event but chances are it won't follow the Bar-B-Que in 1978; that simply makes the evening too long for most people.

From Maxi To Mini

To follow up this year's (inter) national CCOS a twin series of "mini" CCOS meetings are being scheduled. A full announcement of the **"Series-One"** meetings will be found on the insert card **between pages 8 and 9** of this issue of CATJ. "Series-One" meetings will deal with (1) TVRO planning and installation, (2) Gunn/Micro-plexer microwave systems. An announcement of the "Series-Two" meetings, covering aspects of CATV off-air headend design and system maintenance/alignment will appear in the September CATJ. Additionally, all systems within driving distance of the various "mini" CCOS meetings this fall will receive an invitation through the mails to attend the meeting(s) in their area.

The Next "Maxi"

CCOS-78 will be held in the middle of July next year; the CATA Board reviewed all of the arrangements required to select a site and plan the 1978 meeting and determined that for at least 1978 the rural type of "remote" setting would be again followed. CCOS-79 will attempt to select a larger facility however, where **more** of the industry can be accommodated at a central facility. It was a great experience. . .**with more of the same promised in 1978!**

DOLAN ON CALIBRATION. . .

HOW AND WHY ERRORS CREEP INTO SIGNAL LEVEL METER CALIBRATION SYSTEMS

Our world revolves around signal level numbers. Our off-air levels, our headend levels, our plant levels and finally our customer service levels present a bewildering sequence of dBmV this and dBmV that in a never ending series of minuses and pluses. As CATJ has previously visited (**see CATJ** for January 1975, page 22; June 1975, page 29; November 1976, page 41), our measurements are only as good as the equipment we utilize and the equipment we utilize is only as good as the sources of error. Sooner or later we come back to calibration and to calibration standards.

Diagram one shows the calibration "chain"; and it starts as all good things do with the federal government telling us how to make measurements. In this case we have the National Bureau of Standards (N.B.S.) developing not only calibration techniques but also calibration "standards"; which are national references to which all other calibration can be "traced." The second step in our chain is the test equipment manufacturers; and their own in-house calibration reference standards which hopefully are utilized to test and align all test equipment at the time of manufacture, and which also (hopefully) is referenced against (through the chain) the N.B.S. "standard". This level of manufacturer creates not our CATV test equipment but the power meters and other test standards and instruments against which we as CATV test equipment manufacturers reference our own CATV test equipment.

The third level in the chain is the CATV test equipment manufacturer. He utilizes one or more power meter or reference sources for his own production of CATV test equipment. The last and final step in the chain is the end user; the CATV system operator.

by
Larry Dolan
Mid State Communications, Inc.
Beech Grove, Indiana

The N.B.S. Reference

When you start down this chain of measurement references you begin with the agency of the United States government which establishes U.S. standards for our own industry as well as cross-referencing and correlating those standards against similar government standards with the other high-technology nations of the world. This establishes our references for such diverse measurements as the inch, pound, ohm, volt, second and so on. Voltage is our interest here and it is measured or calibrated by translating **power to energy**. Zero dBmV is one millivolt (1/1000th of a volt) across a 75 ohm resistive load. Thus by definition we can translate this into power (we already know the voltage and the resistance so by applying ohm's law we can calculate power) and it turns out to be

THE CALIBRATION SEQUENCE

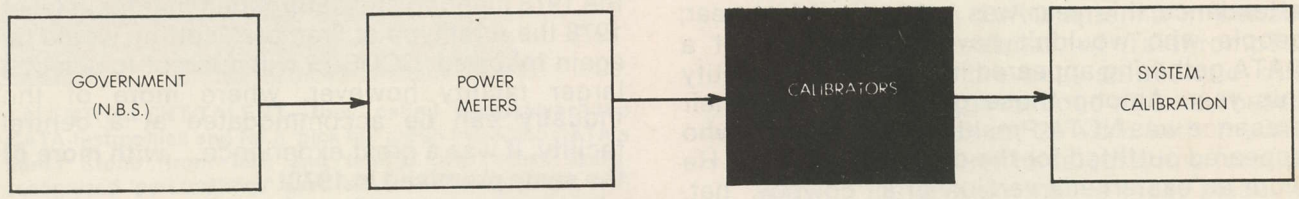


DIAGRAM ONE

13.333 (333 etc.) nanowatts. However we are discussing only power or energy at this point so our 0 dBmV/1 millivolt (1 mV) of signal must be a pure CW **(non-modulated)** carrier. Modulation at this point only gets into the way since it "distorts" the true power present by whatever value of modulation is also present.

Thus the power meter (the device that tells us we have 13.333 nanowatts of CW carrier present when we supply a 1 mV signal across a 75 ohm resistive load) is our second step in our calibration chain. Power meters are seldom found in CATV systems, principally because they have little utility with a modulated (i.e. power distorted) TV carrier. Power meters are found, as a secondary reference or standard, in CATV test equipment manufacturer plants and a typical unit is shown here. To understand the possible errors that do creep into CATV systyem calibration procedures we should discuss the power meters however.

The key thing to remember with the power meter is that it is **not** frequency sensitive. The power meter will translate voltage to indicted power regardless of the frequency of the signal(s) supplied to it. The power meter measures pure power by coupling the input voltage to a device known as a bolometer. This device has the ability to turn an RF carrier into "heat" through a resistive load. As the RF energy heats the sensing element the bolometer "bridge" (a normally **balanced** resistive network) becomes **un**-balanced. As the resistive bridge becomes unbalanced due to the heating by the RF carrier supplied to the unit the bolometer translates the change in the value of the resistive bridge to the total power supplied to the unit. By reading the change in resistive value of the bolometer bridge you in turn are reading the net effect of the RF carrier (i.e. heat) introduced into the device. One final point to remember about RF carriers "heating" a bolometer resistive load... the amount of heat created is a function of the **average** power present. A CW signal has the same average **and** peak power but a modulated signal has different values of both.

HEWLETT PACKARD 430 C power meter is available on test equipment "surplus" market, typically under $200.

Now let's suppose we apply 0 dBmV (or 1 millivolt) to our bridge. This is not very much power and it requires a pretty decent bridge to react accurately to the amount of signal voltage (i.e. power) applied. However if you create **for your own use** a calibration standard which functions at say the +50 dBmV level, there are several do-it-yourself alternatives available. One is the calibrated detector.

A detector turns RF signal into a DC voltage. Detectors are diodes or they can be more complicated arrays of bi-polars or FET's or just about anything else with a "junction" for detection. There are on the market and available a number of detectors which can be supplied to you with a calibration curve for the +50 dBmV region. This gives you a way to construct your own calibration reference system. **See diagram 2.**

The signal source in diagram 2 is a standard signal generator, or a sweep generator in the CW mode (capable of +50 dBmV output). The attenuator is any good quality commercial at-

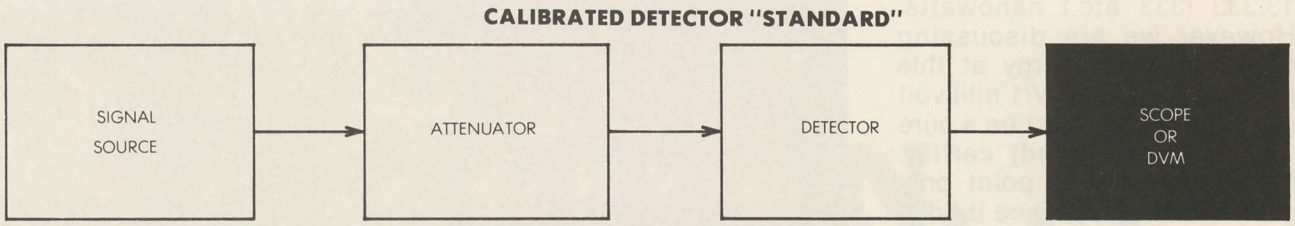


DIAGRAM TWO

tenuator with at least 50 dB of range preferably in 1 dB steps. The **calibrated detector** will typically provide 0.25 volts of DC for +50 dBmV input. To convert your signal generator to a calibration standard adjust its output to attain the 0.25 VDC level on your scope or DVM (digital volt meter). Having set the signal generator (or sweep in CW mode) for the **precise** 0.25 VDC output, any reduction in level **through the step attenuator** will track as closely as the attenuator can track, as long as the output from the signal generator/sweep (CW) source stays constant (i.e. does not drift). Switch in 30 dB of attenuation and the reference calibration signal should be 50 minus 30 or 20 dBmV. The detectors (calibrated) are available in the $35 to $75 region and for +/−0.5 dB accuracy and this is a pretty quick way to go.

Another approach is to browse around the used power meter market. The Hewlett Packard 430C shown here was originally built by the (tens of) thousands and it sells on the used equipment market for between $150 and $200. They have an inherent limitation however. . .they drift (i.e. not totally stable) and they are virtually all in the 50 ohm impedance family. To be sure of what you are doing with such a unit you also need to buy (about $50) or construct (with great care) a 50 to 75 ohm, high quality matching pad.

If you really get the "standards bug" you might look for a Boonton model 42 B. This unit has very low drift, is readily available for the 75 ohm world and will measure levels down to the −10 dBmV range. The price however is around $1000.

Meter Calibrators

As you move down the "calibration chain" you find more and more equipment available to you. For CATV purposes, calibration equipment falls into a pair of broad categories. There are tuneable signal sources and broadband (noise) sources. Shown here are three of the most popular and widely utilized (in CATV) calibration sources; the Sadelco (broadband noise) source, the McGraw-Edison signal generator and the Mid State signal generator. To evaluate the accuracy of your own meters as well as the calibrators we will discuss the calibrators first and study the differences between the single-signal sources and the (broadband) noise source(s).

BOONTON 42 B is current version power meter with 75 ohm input impedance and price tag in $1000 range.

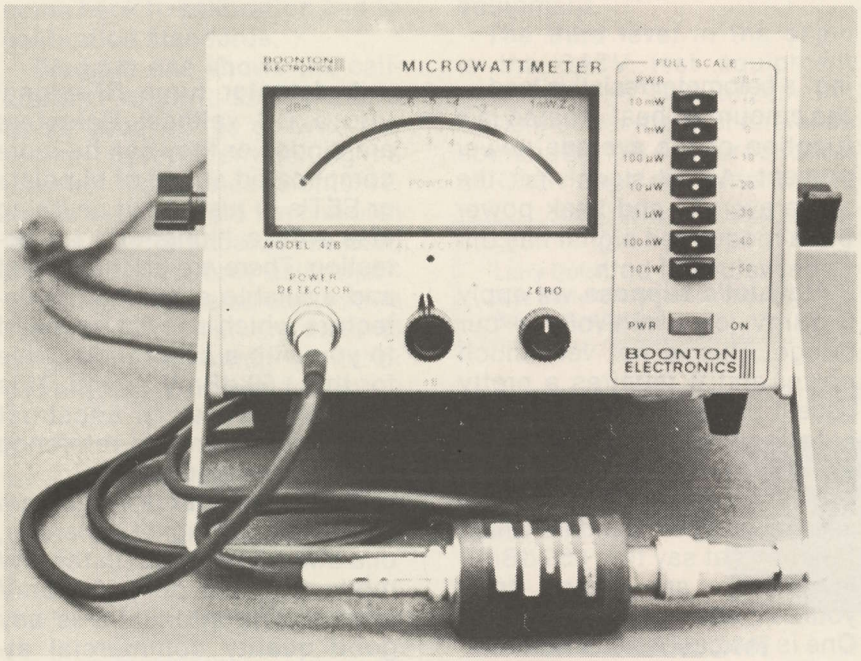


Diagram 3 illustrates in simplified fashion the typical single-signal type meter calibrator. A signal is generated (by an oscillator) and this is fed to a "power monitor" which samples the amount of power present. The sampled power is fed back to the generator/oscillator in a **leveling circuit**. This keeps the output for the system constant regardless of component aging or the frequency of the signal generator. The output level stays constant up through the output of the power monitor stage; thereafter a high quality step attenuator lowers the actual output signal level of the system to the desired level. As you might note this is very similar to the approach taken in diagram 2; major difference being that we have added an automatic level control circuit.

There is however a hidden error here (as there also is with the system shown in diagram 2); and that is related to the purity of the signal generator source. **See diagram 4.** Let's assume our signal source or generator is tuned to 100 MHz and we have a +50 dBmV out-

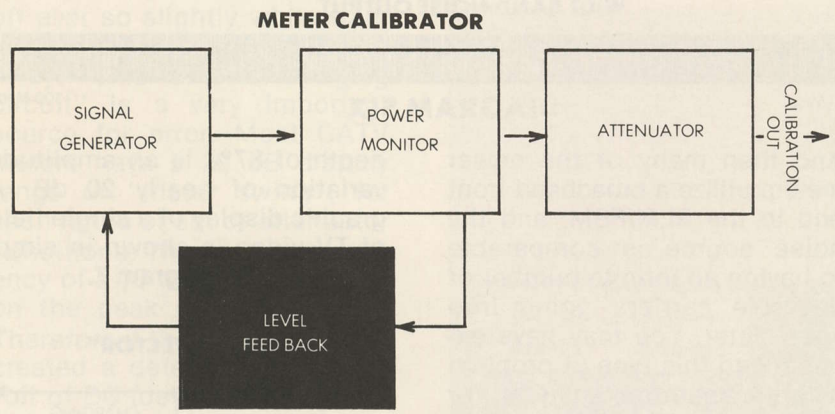


DIAGRAM THREE

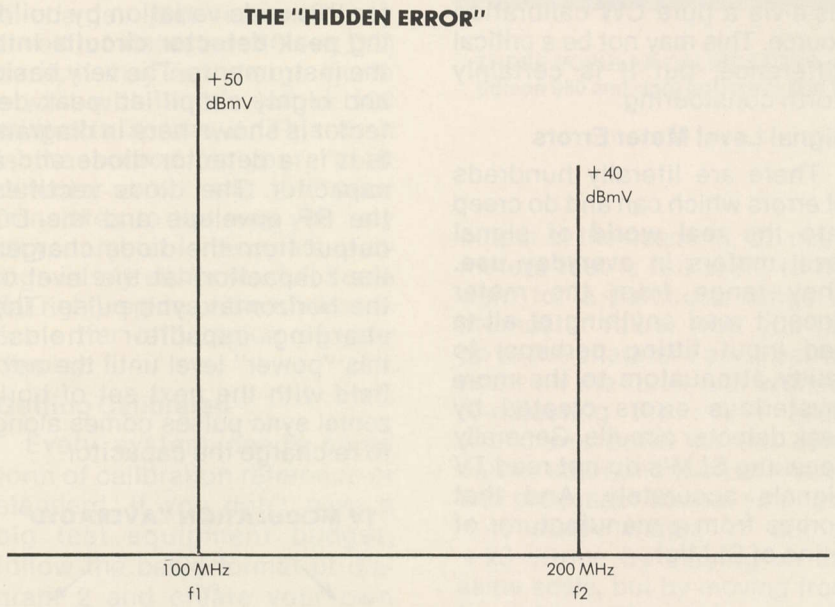


DIAGRAM FOUR

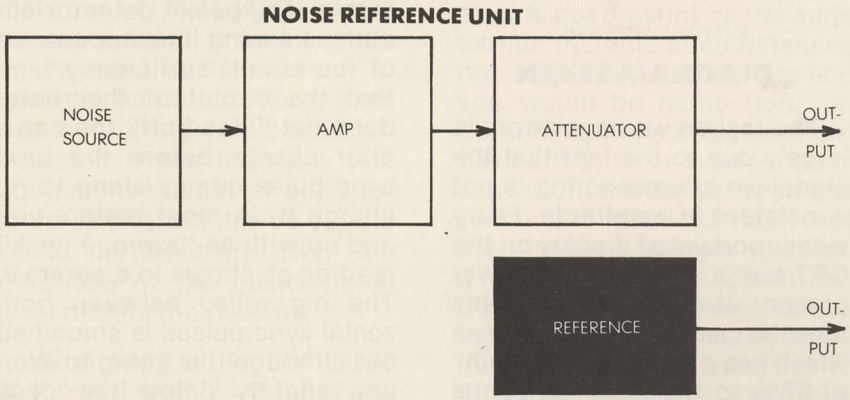


DIAGRAM FIVE

put level registered. Now most broad frequency range signal generator oscillators will have harmonics of the desired frequency present, and in case of our diagram 4 we have a +40 dBmV second harmonic signal appearing at 2 times the desired 100 MHz signal frequency; or 200 MHz. When the calibrator is calibrated with a power meter the power meter sees not only the signal voltage present at 100 MHz but **also** the signal voltage present at any harmonics of 100 MHz, such as 200 MHz. It sums all carriers present and tells you the **total power** of **all** monitored. Remember the power meter is frequency insensitive.

However your FSM/SLM **is** frequency selective; it will see or monitor **only** the desired 100 MHz signal. If the power meter has been utilized as a reference to create a +50 dBmV reference then your reference signal at 100 MHz will actually be lower than the +50 dBmV level you wanted and expected, by whatever amount of "error" is introduced by the presence of harmonics of the signal generator. The presence of harmonics plus spurious signals coming out of your calibrator can create calibrator "reference" errors of in excess of 1 dB; the exact amount of error will depend upon how many non-desired signals are emitting from the calibration reference oscillator and their voltage/power level(s). There is an answer of course; better quality signal sources and the use of band switching. Carefully designed signal generators can control (although not eliminate) spurious and harmonic output signals, while band switching affords you the ability as a system designer to "dump" certain frequency ranges in band-pass or high pass or low pass filter networks incorporated into the band switching system. In the instruments shown here if you spend money in the $500 to $700 calibrator range you can expect to find harmonic signals attenuated by at least 25 dB and the overall accuracy of the system is at least in the +/– 1.25 dB region.

Another approach, that taken by Sadelco in their model 260-B Spectrum Calibrator, is shown in simplified form in **diagram 5.** Because all calibration is referenced to power it is not possible to use broadband noise to calibrate a meter **unless** you know the meter bandwidth very precisely. In other words, you have to be able to determine how much noise falls inside of the IF bandwidth of the FSM/SLM in order to translate that "noise power" into absolute power reference of single frequency CW source. The Sadelco 260-B very ingeniously utilizes a CW source (in the 73 MHz region) as an internal "primary reference" and then allows you to calibrate the broadband noise against that calibrated CW source. The 260-B has the same attenuator accuracy limitation as the single (tuneable) frequency calibrated source plus it must rely on the broadband amplifier internal to the unit to remain essentially flat with constant gain (as it amplifies the wide spectrum of broadband noise). Being in the CATV business can cause you to mistrust units that depend upon a broadband amplifier not changing its characteristics; but this unit does it surprisingly well. This is an admission given begrudgingly by a competitor of Sadelco!

There is a hidden potential error in this system however. Noise is defined as **random** dignals **uniformly distributed** throughout a **band** of frequencies. The problem comes when the noise is not 100% uniformly distributed; and the system relies on averaging several frequencies (adjacent) to achieve an average "flat band" of (noise) energy. In the real world the better the signal level meter (SLM/FSM), the narrower the IF bandwidth of the unit. This is where you get your resolution or the ability to tune between nearby-adjacent carriers and separate them individually for meter display. This also means that as you sharpen the IF bandwidth you capture **less** noise **within** the bandwidth.

WIDE BAND NOISE OUTPUT

0 MHz 300 MHz

DIAGRAM SIX

And then many of the newer meters utilize a broadband front end in the SLM/FSM; and the noise source is comparable to having an infinite number of descrete carriers going into your meter. You may have experienced this type of problem with the spectrum analyzer, for example; too many carriers into the machine causes it to give false readings. It has been found that errors of 0.5 dB are not uncommon when utilizing the broadband noise source as a calibration reference standard vis-a-vis a pure CW calibration source. This may not be a critical difference, but it is certainly worth considering.

Signal Level Meter Errors

There are literally hundreds of errors which can and do creep into the **real world** of signal level meters in **everyday use.** They range from the meter doesn't read anything at all (a bad input fitting perhaps) to faulty attenuators to the more mysterious errors created by peak detector circuits. Generally speaking SLM's do **not** read TV signals accurately. And that comes from a manufacturer of a line of SLM's!

REAL-WORLD TV MODULATION

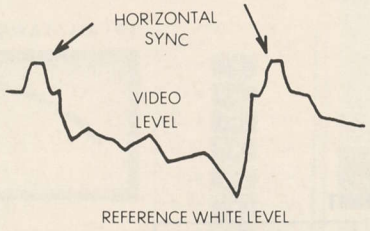


DIAGRAM SEVEN

The reason we have errors is largely due to the fact that the signal we are measuring is **not** consistent **in amplitude.** Every video-modulated display on the CRT has a new level of power present at our SLM/FSM. This runs the gamut to a white screen which has a modulation "depth" of 87% to the peak horizontal sync pulses. A modulation depth of 87% is an amplitude variation of nearly 20 dB. A graphic display of a single field of TV video is shown in simplified form in **diagram 7.**

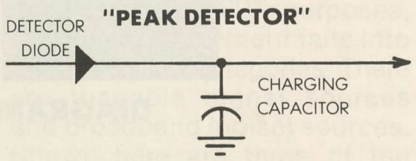


DIAGRAM EIGHT

SLM/FSM instrument manufacturers attempt to **correct** for this wide variation by building **peak detector circuits** into the instruments. The very basic and highly simplified peak detector is shown here in **diagram 8.** It is a detector diode and a capacitor. The diode rectifies the RF envelope and the DC output from the diode charges the "capacitor" at the level of the horizontal sync pulse. The charging capacitor "holds" this "power" level until the next field with the next set of horizontal sync pulses comes along to re-charge the capacitor.

TV MODULATION "AVERAGED"

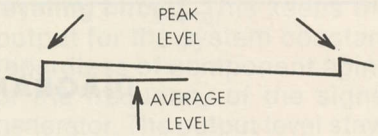


DIAGRAM NINE

This sounds simple enough but there is a design problem with such "peak" detector circuits; keeping the impedance of the circuit sufficiently high that the circuit of the meter does not "bleed off" the capacitor charge **before** the next sync pulse comes along to recharge it. In most meters you end up with an "average peak" reading as shown in **diagram 9.** The big valley **between** horizontal sync pulses is smoothed out although it is going to average slightly below the peak sync pulse level and it will taper

off ever so slightly while waiting for the next sync pulse to fly by. **This** "detector charging circuit" is a very important source for error. Most CATV meters have a 20 dB display range or "meter swing"; for each range or set of attenuator conditions. This is the equivalency of a 10 to 1 voltage range on the peak detector circuit. Therefore if the meter designer created a detector that has 1 volt of DC (detected RF) at the **full scale** point (far right on your meter), the meter has only 1/10th or 100 millivolts present on the detector at the **minimum-scale** (far left on your meter) point. The charging capacitor is voltage-present conscious. It charges just fine with say 1 volt of detected RF (or DC) on it; it may not charge worth a whit with 1/10th volt or 100 millivolts across it. This then is the source for your "peak detector error" and this error translates to the way you rely on your meter for accurate readings in say either the full scale (far right) region or the minimum-scale (far left) region of your display.

Getting Calibrated

Every system needs some form of calibration reference or standard. If you don't have a big test equipment budget, follow the basic format of diagram 2 and create your own standard. One suggestion here however; you should install a simple high pass/low pass filter between the signal source and the detector (such as a Channel Master 7007 high-low splitter unit for under $7.00) to insure that your 100 MHz signal source reference signal is pure enough at the input to the detector to keep any harmonic energy from mis-calibrating the calibrated detector. If you have any test equipment budget at all, a system calibration device should come immediately after the purchase of the basic signal level meters themselves.

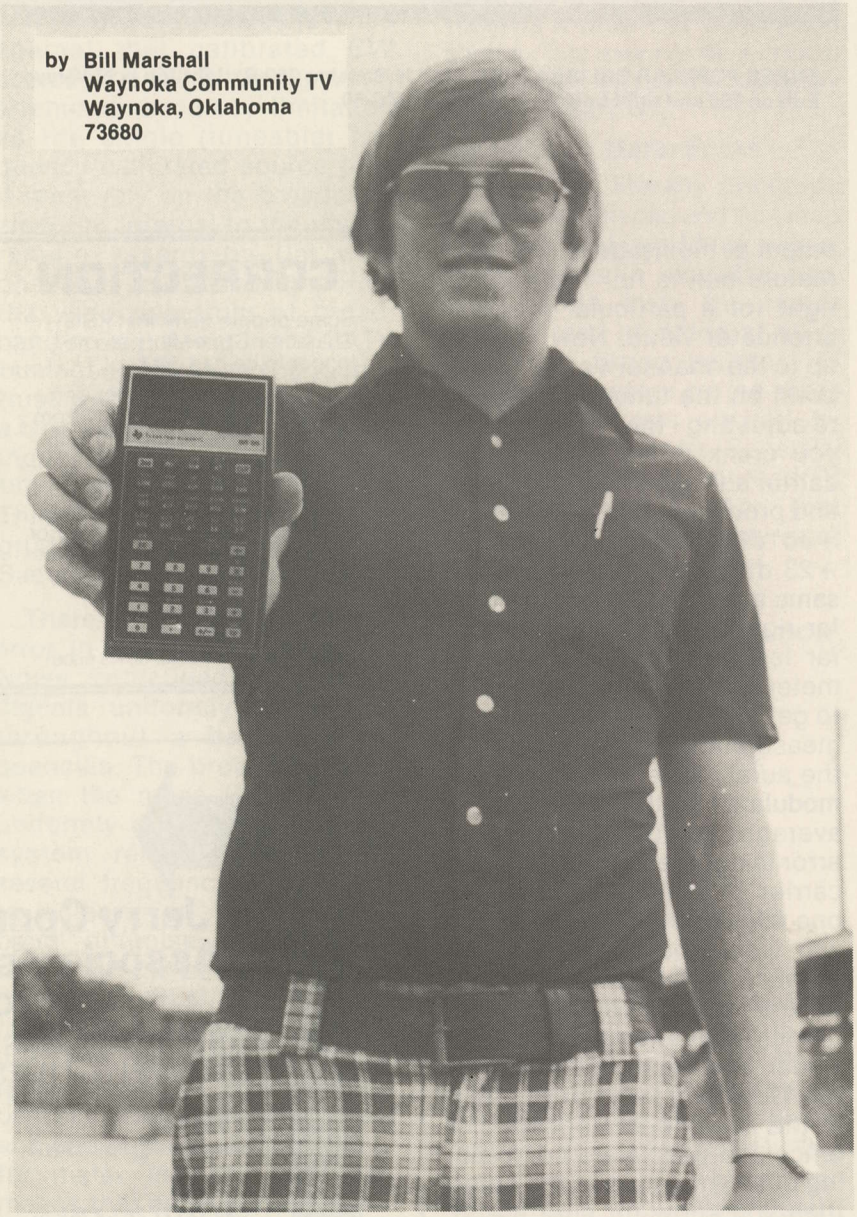
What does all of this mean in the real world? Let's say you set channel 4 at +40 dBmV output at the headend. On many meters that is full scale to the right for a particular range of attenuator value. Now you flip up to the channel 4 aural carrier point on the tuner and **without** re-adjusting the meter scale you crank down on the aural carrier adjustment on the headend processor so that you have +40 dBmV minus 17 dB; or +23 dBmV. **By staying on the same scale,** but by moving from far right on the scale range to far left you have allowed the meter peak detector efficiency to get in the way of an accurate measurement. On top of this the aural carrier is FM, **not AM modulated** so the peak detector average versus peak power error **is not** present on the aural carrier. In some circumstances one **might** cancel the other and you would be home free. . .in other circumstances you **might have** either 19 or even 21 dB of carrier **difference** between the visual and aural carriers; **not the 17 dB you thought you had.** If the telephone rings in the office and people are complaining of a (sync) buzz in the audio then you know for sure the 17 dB difference is really more than 17 dB afterall!

THREE POPULAR CALIBRATORS—left is Sadelco 260-B, right top is McGraw-Edison 950 and right bottom is Mid State MC-50.

PROGRAMMABLE CALCULATOR SPEEDS CATV FEEDER SYSTEM DESIGNS

Register 2—Speak To Me!

by Bill Marshall
Waynoka Community TV
Waynoka, Oklahoma
73680



AUTHOR BILL MARSHALL computes complete CATV feeder line layouts in minutes, not hours, using SR-56 programmable calculator.

A Happy Marriage

One of the most exciting advances in electronics (aside from CATV. . .of course!) is the recent maturing of the programmable pocket calculator. A fully programmable pocket calculator with addressable memories and many other features is now rather universally available for less than $100; with a few more bucks buying what would just a few short years ago have required a six foot rack just to hold all of the functions.

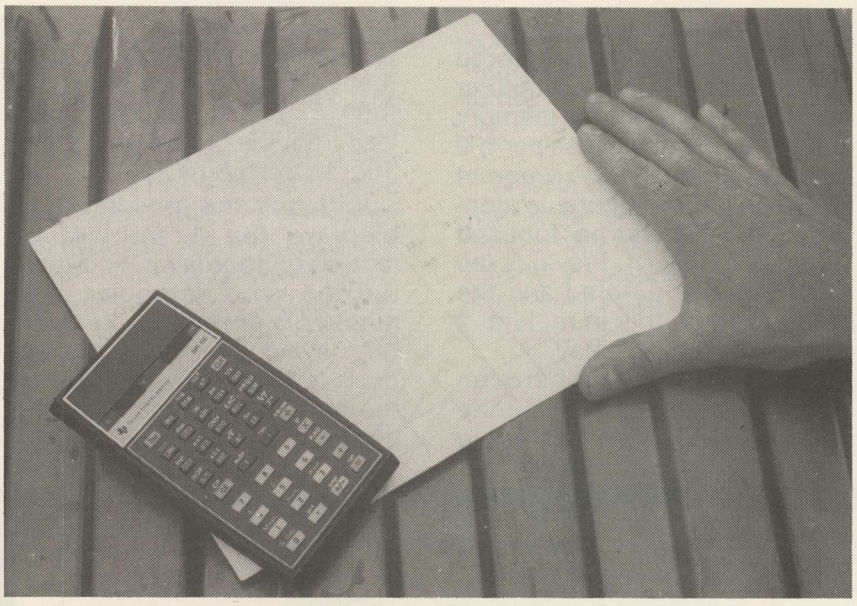
After owning a Texas Instruments **SR-56** for a couple of months and studious study of the programs supplied with the calculator, I began to think about how the pocket "computer" could be applied to the everyday world of operating a CATV system. It so happened that our system was just entering the final planning stages of a complete rebuild and this presented me with an opportunity to see if the SR-56 could be "programmed" to assist me in laying out the new system. Anyone who has gone through this exercise is already aware that if you do it correctly, the location of taps, and the selection of taps, is a most time consuming task. I suspect that many people simply start off with a known tap isolation value immediately following a line extension amplifier, and then working from a "gut feel" based upon having done the same job numerous times be-

fore, they walk their way down the tap isolation scale until they hit the input to the next feeder (extender) amplifier.

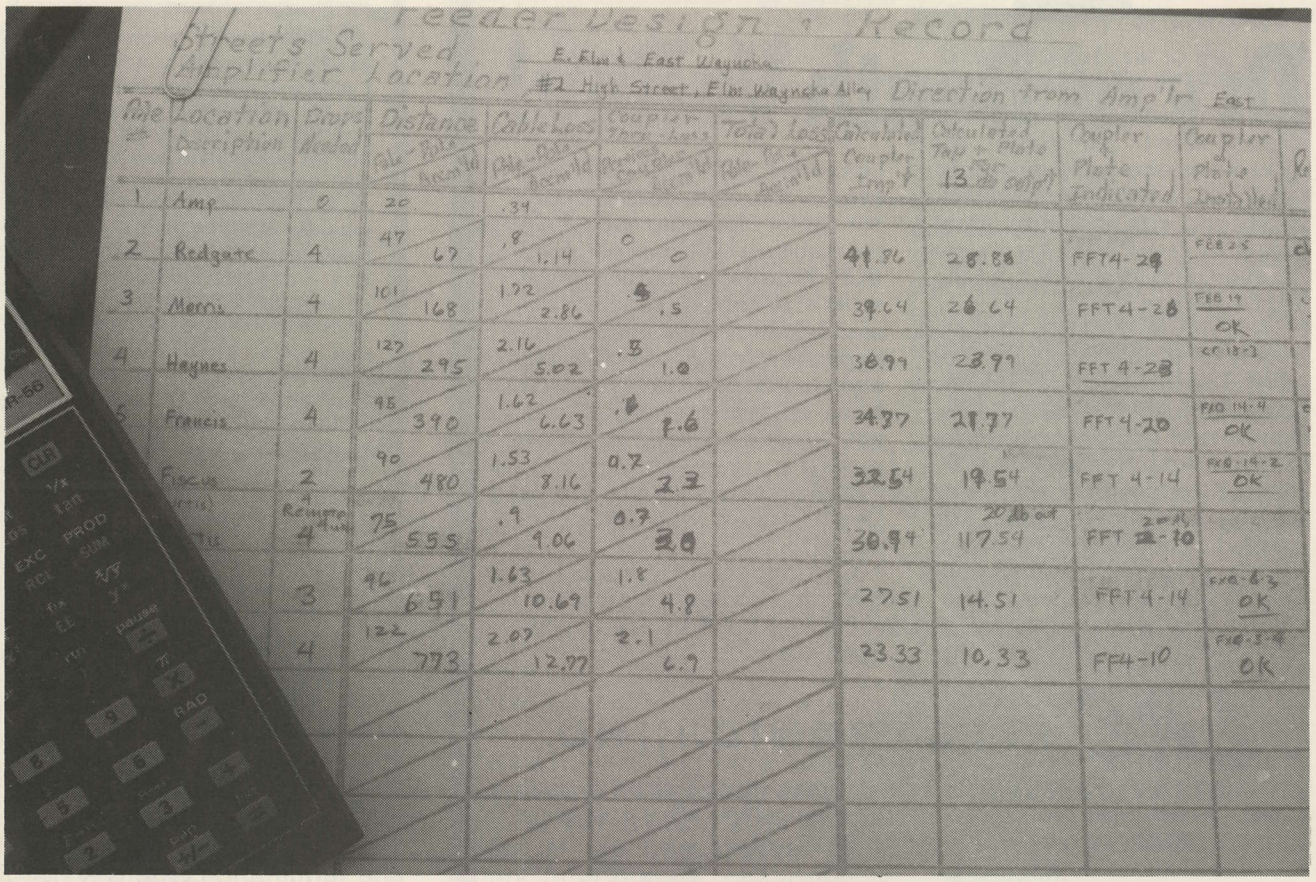
Not being as experienced at laying out a system, and recognizing the inherent challenge of doing it properly, I decided to combine the programmable challenge of the SR-56 with the job at hand; and to develop a program to calculate the feeder (and tap) design for the rebuilding project. Afterall, any mathematical problem or repeated calculations can be programmed and once programmed the solution for a particular problem computed in seconds.

Given the amplifier output level, the cable loss per 100 feet, a chart of tap thru losses and the distance between tap locations, an entire feeder line can be calculated and tabulated in less than ten minutes time. In the process, the total cable loss, total tap loss (thru), and the total cable length can be accumulated and stored in separate registers.

The program developed, prepared using the SR-56 "Coding Form" (for constructing your own programs) is shown separately here. If you do **not** have an SR-56 type calculator, this may seem like so much "Greek" to you. For those who are "into" programmable pocket calculators, the process and procedure will be self explanatory. Again for those who are not into using these electronic wizards, for less than $100 and some "familiarizing time" you too can be a walking, talking "computer programmer"!



A TRADE FOR TIME—by letting the programmable calculator do the work, valuable CATV personnel time is freed for things the calculator still can't do. . .such as running a drop!



PLANNING AND INSTALLATION record are complete package, including directional tap part value and level.

Walk Through. . .

After the program is entered into the calculator, the amplifier output level is stored in memory register 0. The cable loss per 100 feet is entered and the program is started. **This figure is converted to cable loss per foot** and stored in register 1. Previous tap loss (if any) is entered and the program sums this in register 2 and recalls 2 for display.

The cable distance between spans (taps) is entered and the program calculates the cable loss for that span, rounds it off to one decimal place, displays that number momentarily, and then displays the **total** cable loss from the output of the amplifier to that point.

Initiating the program again displays the directional tap (coupler) input level, and again the tap value is shown. This number is entered on your system layout sheet and the program is now ready to calculate the next tap isolation. The amplifier output and the cable loss per 100 feet do not need to be re-entered; they are "on store" at this point.

Note that in program steps 38 and 39 you are working with the desired output signal level from each tap (i.e. programming this value into the machine). This can be changed to suit the desired tap output level for your application or system. Also note that after each feeder line (leg) is computed through to the end of line termination, you will need to clear the memory registers

CATV Feeder Design

Location	Code	Key
00	54	÷
01	01	1
02	00	0
03	00	0
04	94	=
05	33	STO
06	01	1
07	41	R/S
08	35	SUM
09	02	2
10	34	RCL
11	02	2
12	41	R/S
13	35	SUM
14	04	4
15	64	X
16	34	RCL
17	01	1
18	94	=
19	49	*fix
20	01	1
21	59	*pause
22	35	SUM
23	03	3
24	34	RCL
25	03	3
26	41	R/S
27	34	RCL
28	00	0
29	74	–
30	34	RCL
31	02	2
32	74	–
33	34	RCL
34	03	3
35	94	=
36	41	R/S
37	74	–
38 (note)	01	1
39 (note)	03	3
40	94	=
41	41	R/S
42	22	GTO
43	00	0
44	08	8

Registers

0—Amplifier **output**
1—Cable **loss**/foot
2—Total DT (thru) **loss**(es)
3—Total cable **loss**
4—Total cable **length**

NOTE: This is for +13 dBmV tap output level; enter your own appropriate (desired) output level.

before you begin calculating the next feeder line leg.

Conclusion. . .

This program, as programs go, has been intentionally kept simple and straight-forward. There are undoubtedly many variations and improvements which could be added to adapt it to your own particular needs. As your familiarity and understanding of the programmable calculator "gels" your own programs for your own needs can be easily developed. With a programmable calculator and some imagination there is no longer any need for the skilled CATV person to shy away from everyday calculations required to operate and maintain your community antenna television system.

(CATJ note: Other readers who have developed programmable calculator "programs" for CATV use are invited to submit them to **CATJ**.)

220 MHz Class E CB Interference. . .

A Proposed VHF-FM Citizens Band Radio Service Would Present A New Set Of Interference Problems

The Federal Communications Commission is presently wrestling with several proposals to create a new band of frequencies for CB (Citizens Band) two-way radio. One of the serious contenders for the frequency assignment is the 222-225 MHz region; a segment of an existing amateur radio service band. Working against this proposal are the present occupants (the amateurs) and an FCC study which details how transmitters operating in the 223-225 MHz region can cause moderate to severe television interference with reception on VHF channels 11 and 13, and UHF channel 47.

Robert W. Brandel, an engineer with the E.F. Johnson Company (Waseca, Minnesota) has done extensive laboratory and field work in this region to determine the extent of interference that would occur with such a new CB service. His findings are of interest to the CATV industry primarily because many of the solutions he offers borrow from existing CATV trap and filter technology, and also because if the FCC should re-allocate the 222-225 MHz region to a new CB service, all CATV systems with off-air pick-ups on television channels 11, 13 (and 47) might be affected.

by
R.W. Brandel
E.F. Johnson Company
Waseca, Minnesota
56093

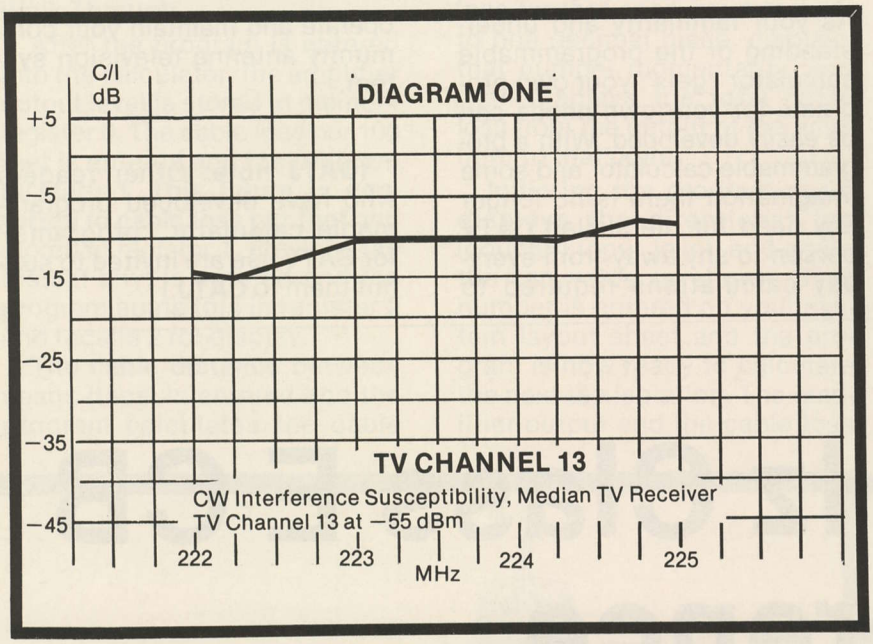
TVI Causes

Operating a 222 to 225 MHz 10 watt transmitter in the near vicinity of a VHF television receiver system could result in two predominant modes of interference: (1) **Desensitization** of the television tuner RF circuitry when tuned to Channel 13, and (2) **Fourth order intermodulation** (half-IF) when tuned to Channel 11.[1] These interference conditions occur when the desired television signal **ca**rrier (C) to undesired Class E signal **in**terference (I) ratio, C/I, drops below a specific required minimum. The source of the interference is the strong, local Class E transmitter carrier field level at 222 to 225 MHz. The effect of the transmission is video interference occurring within the television receiver.

ALTERNATE TVI SOLUTIONS

Several solutions to the Class E-TVI problem exist at varying degrees of economic and practical feasibility. This section includes a brief review of various methods of TVI reduction and considers the effectiveness of each solution. In each case, the objective is to increase the television signal **ca**rrier to Class E **in**terfering signal ration, C/I.

1. **Increase the television signal power level.** The most obvious way of increasing the C/I ration would be to increase C directly. This can be done by increasing either the television transmitter output power or antenna gain or both. The economic requirements of this approach limit its practicality. Present legal restrictions as well as the increased potential for co-channel interference, combined with the prohibitive costs of implementation, limit the practicality of this approach.
2. **Reduce the Class E trans-**



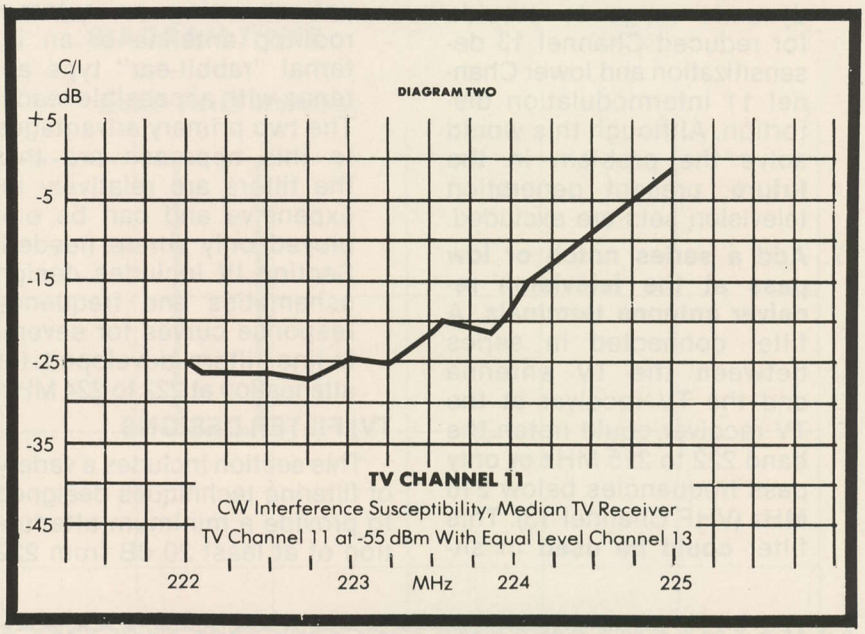
mitter output power from 10 watts to a lower, interference free level. By lowering the Class E signal level, I, the C/I ratio is increased. A direct tradeoff results between Class E two-way communications range and radius of potential television interference. As an example, consider the effects of a 6 dB Class E transmitter power reduction (10 watts to 2.5 watts). The net effect would be to reduce the potential radius of TVI (near field) by 50% while reducing the theoretical transceiver communications area (far-field) by approximately 50%.

3. **Locate the Class E service at a TVI free frequency.** A logical approach to providing maximum compatibility would be to locate the most populous radio communications services at frequencies least likely to cause interference. A recent FCC[2] release regarding possible frequencies included only two alternative bands: Expansion of the present 40 channel service near 27 MHz and/or allocation of channels at 900 MHz. At 27 MHz, the present 'skip' propagation and high power linear amplifier availability may offset the advantage of lower TVI probability. The potential high cost of 900 MHz could be a deterrent to 900 MHz population for the next few years. TVI variations with frequency within the 222 to 225 MHz band are illustrated in diagrams 1 and 2 at a received TV signal level of −8 dBmV.[3]
4. **Restrict the Class E service to use only vertically polarzed transmit antennas.** The cross polarization of the vertical Class E transmitting antenna and the horizontal television receiver antenna results in 6 to 24 dB of polarization discrimination. In the near future many television stations will be changing from horizontal to circular or elliptical transmitter antenna polarization to reduce

video signal reflection "fading" and "ghosting" effects. Based on the assumption that a 3 dB power increase is included with a change to circularly polarized transmissions to maintain horizontal ERP levels, the following table list the C/I ratio changes which occur at different combinations of TV transmitter, Class E transmitter and TV receiver antenna polarizations.

TV Transmitter	Antenna Polarization TV Receiver	Class E Transmitter	Polarization Discrimination (C/I)-Nominal
H	H	V	-18 dB
C*	H	V	-18 dB
C*	C	V	- 6 dB
	H = Horizontal V = Vertical C = Circular		

5. **Design and build television receiver antennas with a 222 to 225 MHz trap filter.** This solution would be effective for separation distances greater than 85 feet between the Class E transmitter and TV receiver antennas where the predominant interfering signal is received via the TV antenna. It generally would not prove effective for radii less than 85 feet due to the lack of common mode rejection in the television receiver from signals picked up directly in 300 twin lead transmission line, or through the television receiver's internal circuitry.
6. **Design the television receivers for lower interference susceptibility.** Circuit design improvements are needed in two areas. First, additional selectivity in the television tuner in the form of a low pass filter at frequencies above TV Channel 13 is needed to further attenuate the Class E signal at 222 to 225 MHz. Second, active stage design must focus on greater



dynamic range to provide for reduced Channel 13 desensitization and lower Channel 11 intermodulation distortion. Although this would solve the problem in the **future**, present generation television sets are excluded.

7. **Add a series notch or low pass at the television receiver antenna terminals.** A filter connected in series between the TV antenna and the TV receiver at the TV receiver could notch the band 222 to 225 MHz or only pass frequencies below 216 MHz (VHF Channel 13). This filter **could be used** in situations using an external roof-top antenna or an internal "rabbit-ear" type antenna with accessible leads. The two primary advantages to this approach are that the filters are relatively inexpensive and can be employed only where needed. Section IV includes design schematics and frequency response curves for several in-line filters developed for attenuation at 222 to 224 MHz.

TVI FILTER DESIGNS

This section includes a variety of filtering techniques designed to provide a minimum attenuation of at least 20 dB from 222 to 224 MHz. (See diagrams 3 through 8). The spectrum response is also noted at relevant TV channel frequencies. Filters using coaxial, stub-tuned notch techniques were favored due to their ease of construction and notch frequency consistency.

FILTER PERFORMANCE SUBSTANTIATION

In order to verify the lab-bench test results of the filters, an interference condition was established at a typical household in Waseca, Minnesota. Filters were then added to note the effects of filtering on radius of interference of the Class E mobile transmitter. The following test data were compiled:

TEST CONDITIONS

TV Channel: 11
TV Receiver Antenna Height: 30 feet
TV Received Signal Level: -17 dBmV
Frequency of Interfering Signal:
223.0125 MHz, 10 watts - mobile

DIAGRAM THREE

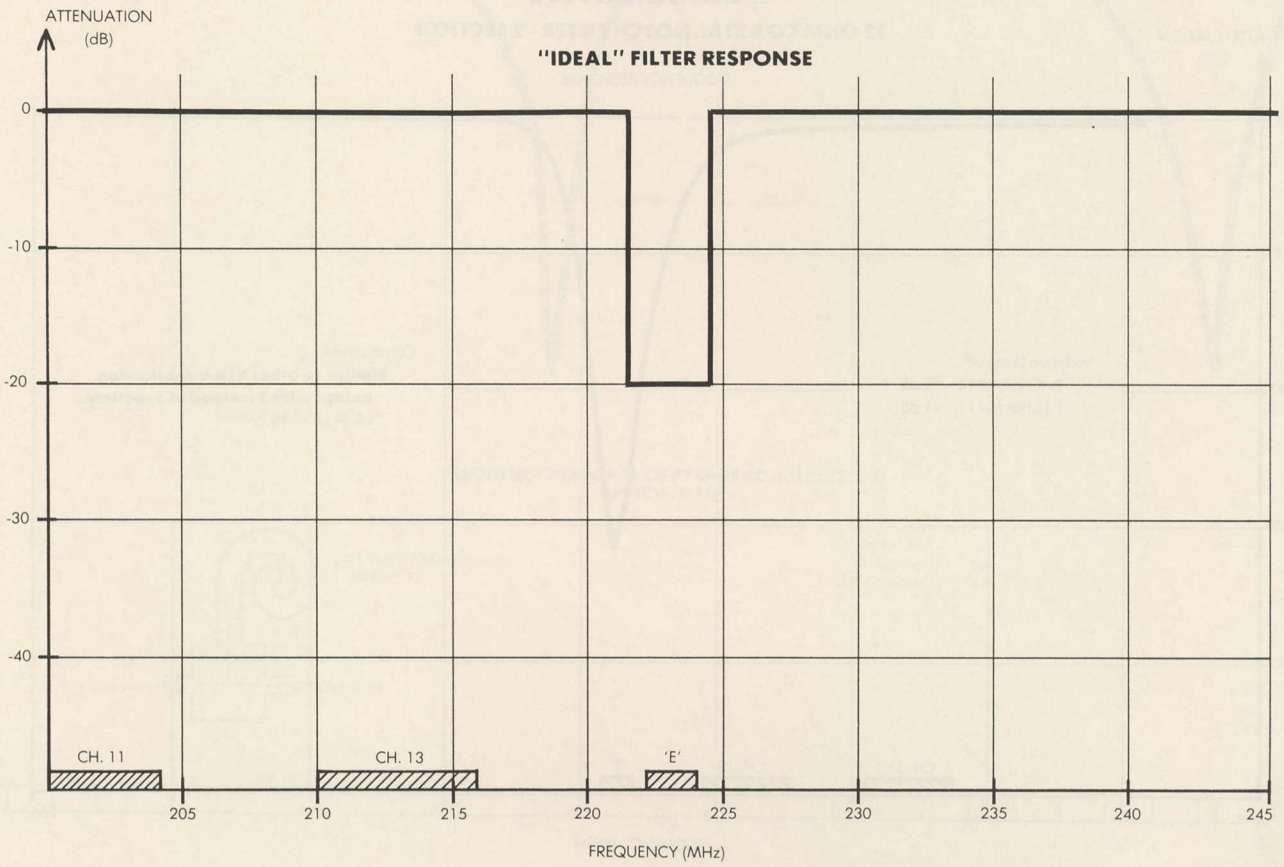


DIAGRAM FOUR

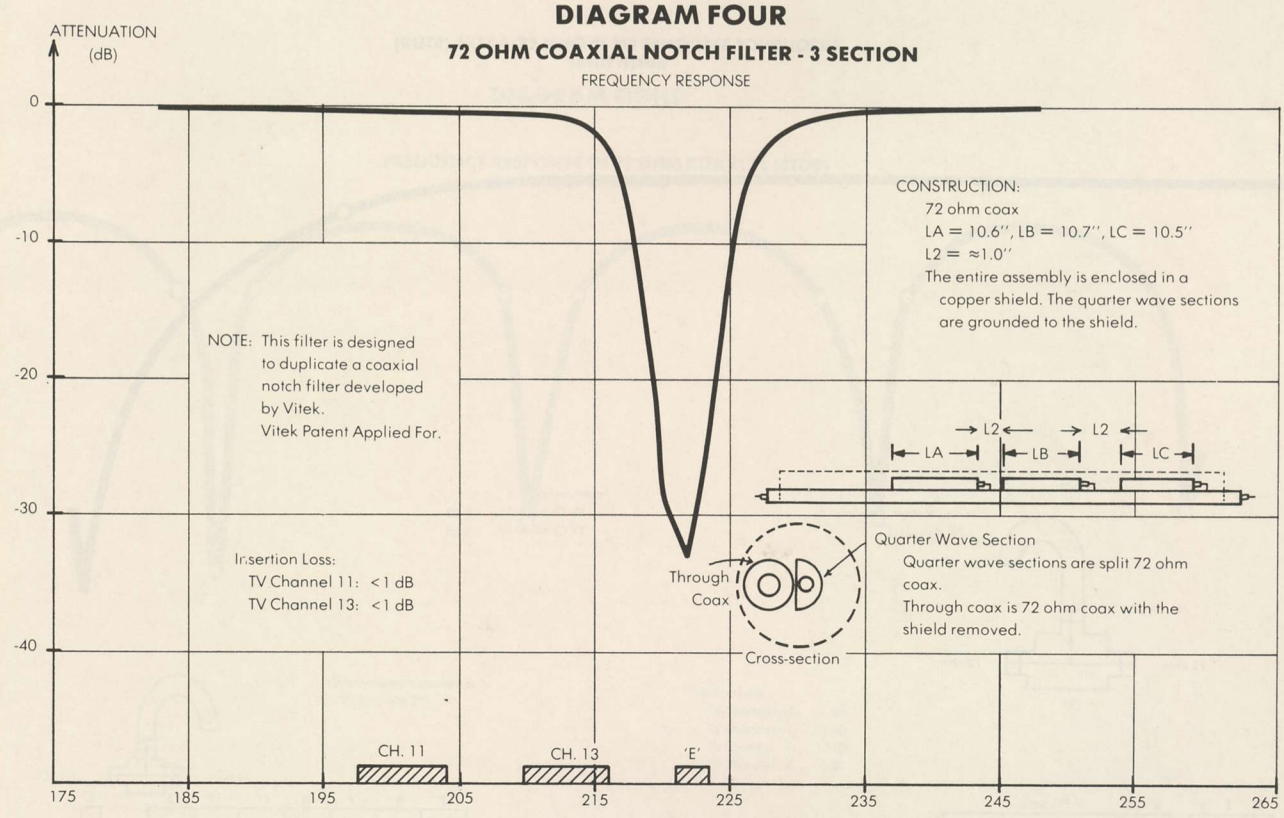


DIAGRAM FIVE

72 OHM COAXIAL NOTCH FILTER - 2 SECTION

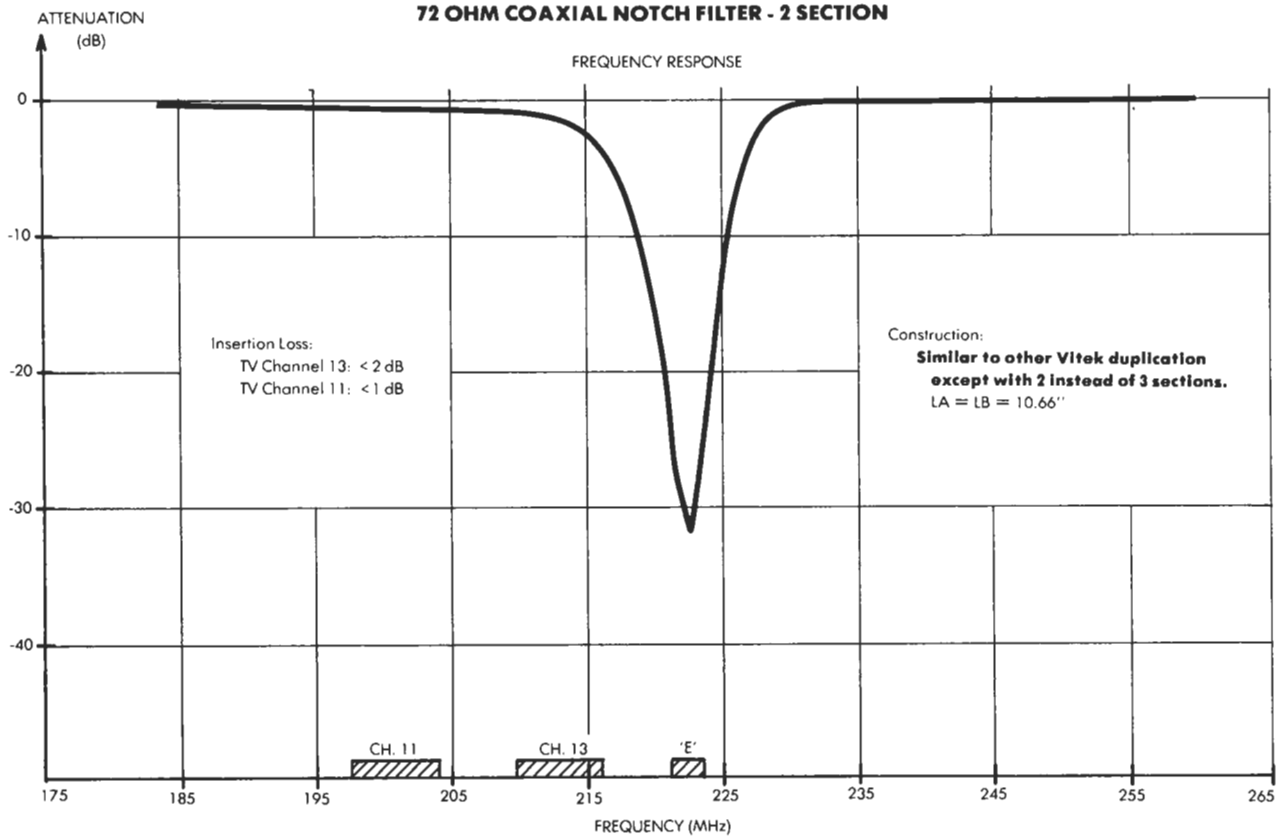


DIAGRAM SIX

FREQUENCY RESPONSE OF 72 OHM COAXIAL (STUB) notch filter

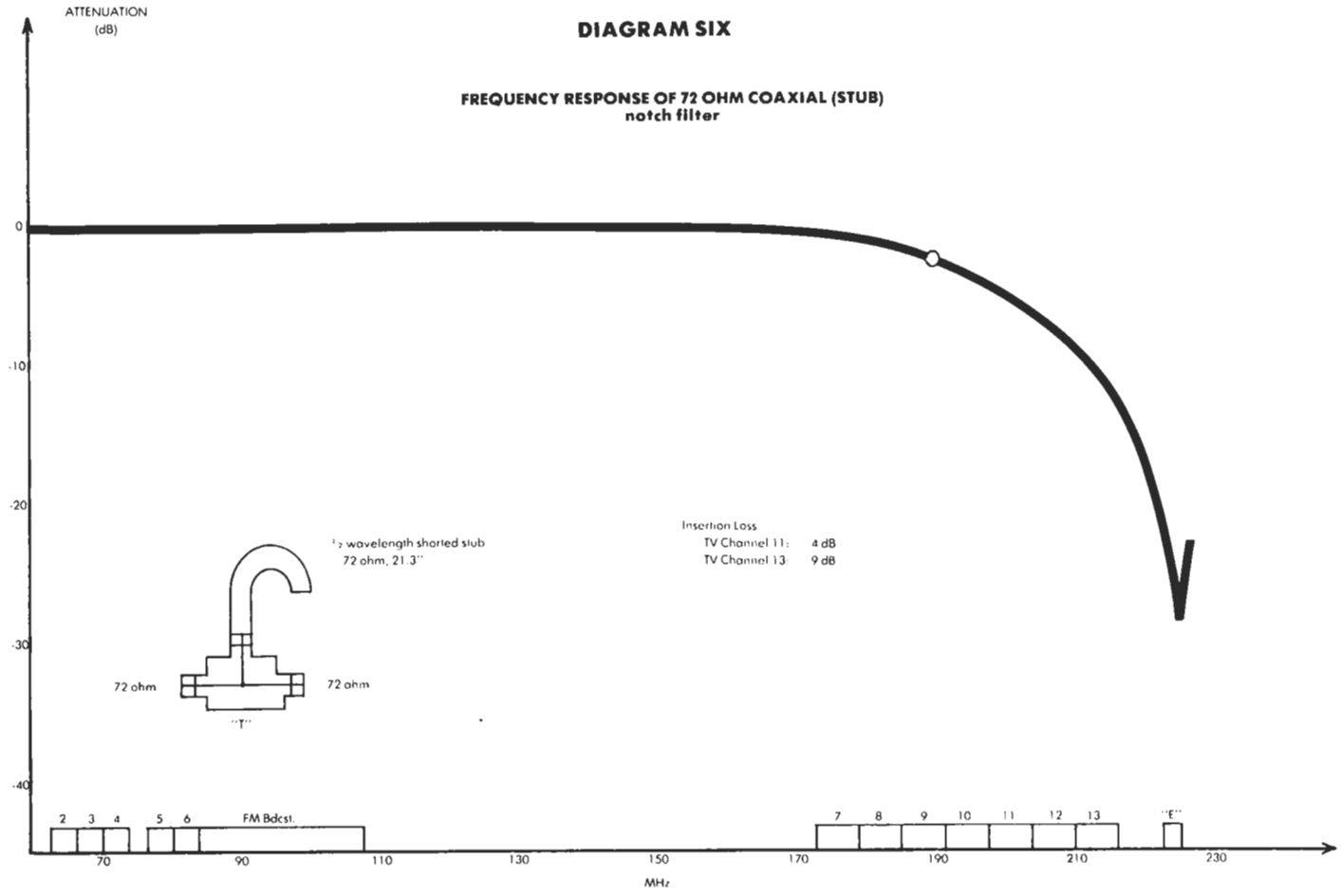


DIAGRAM SEVEN

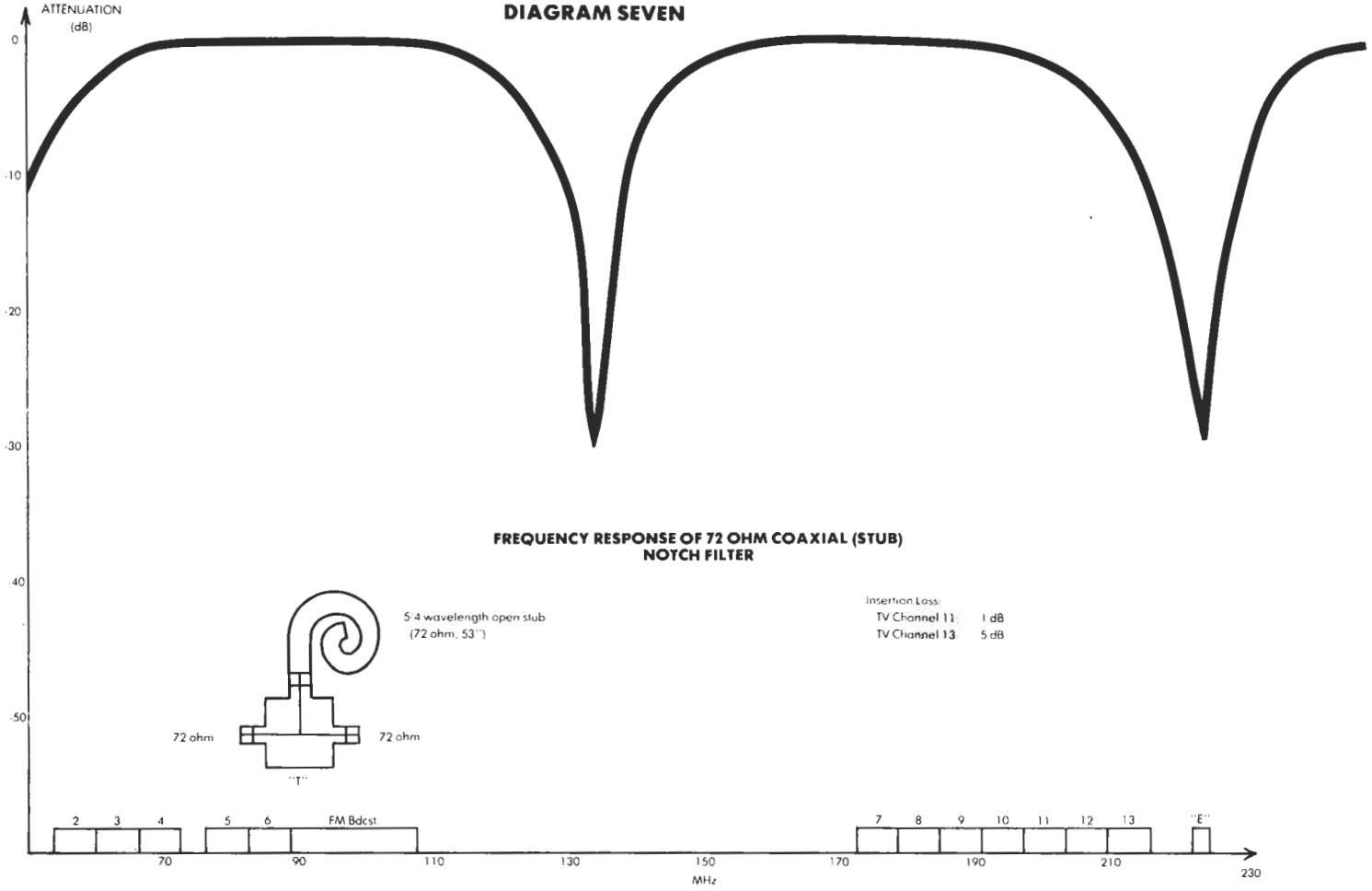


DIAGRAM EIGHT

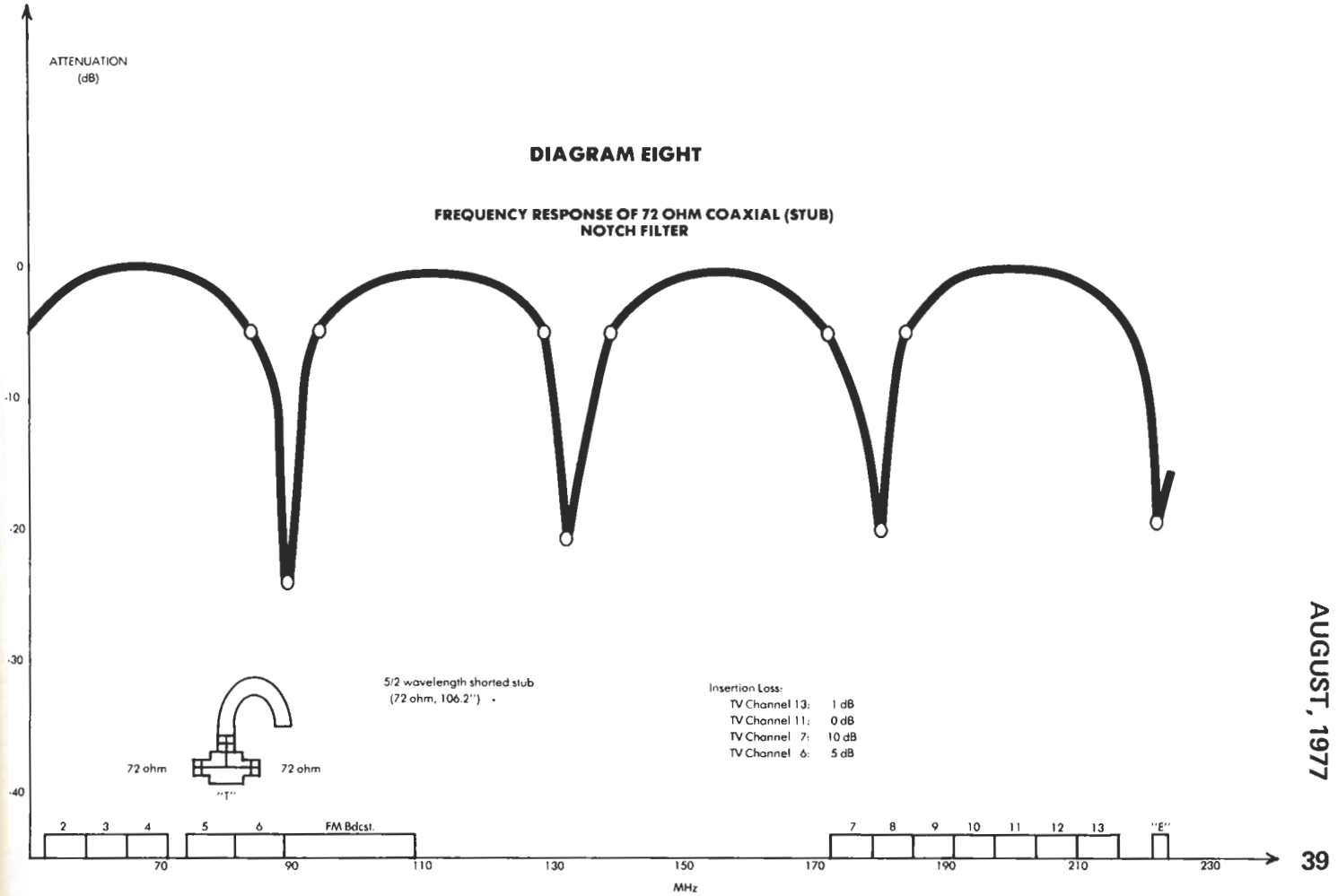


DIAGRAM NINE

FOUR SECTION DISCRETE COMPONENT FILTER

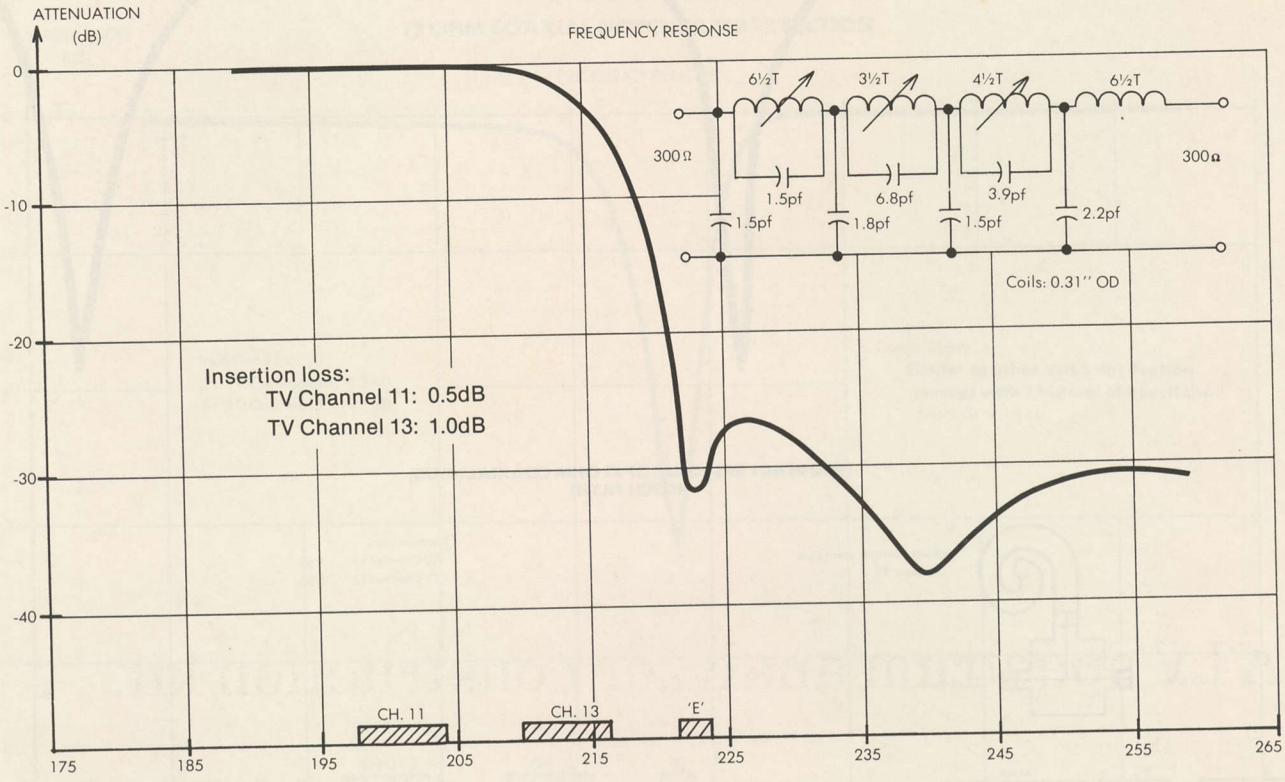
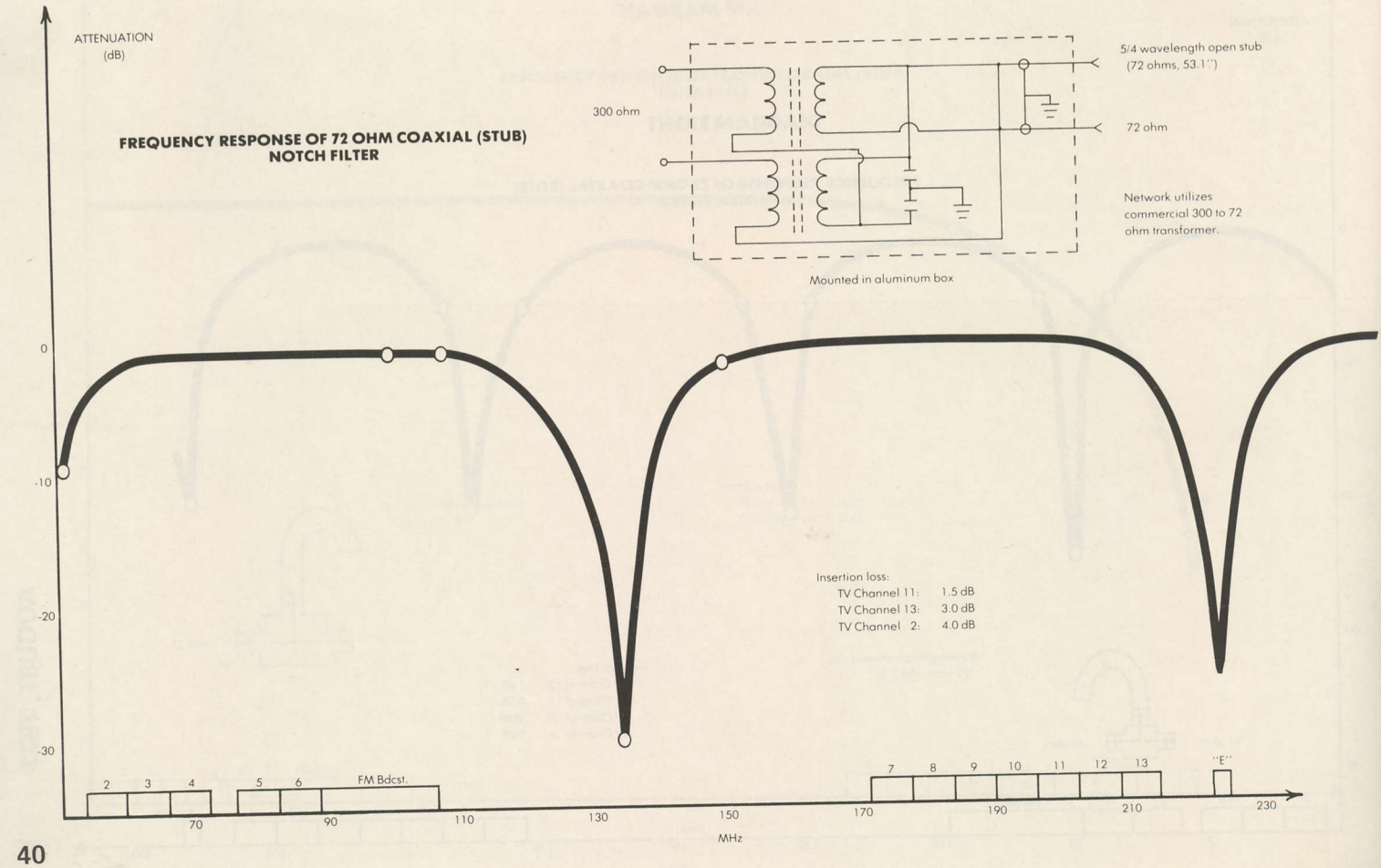


DIAGRAM TEN



TEST PROCEDURE

The mobile unit with 10 watt transmitter was driven toward the television receiver installation from a distance of 1000 feet until just perceptible interference was noticed. With this distance recorded, a filter was added at the television receiver. The mobile unit was again driven toward the household until interference again became just perceptible. This was done for several filters. Television receiver system to mobile transmitter separation was defined as the distance between the mobile automobile roof center antenna mount point and the house roof-top TV antenna or twin lead, whichever was closer.

CONCLUSION:

Test results indicate that low cost filtering techniques could reduce the TVI problem resulting from 222 to 225 MHz transmissions to acceptable levels. A wide variety of filters exist to satisfy varying requirements. Those filters can be easily installed by following simple instructions.

Filter	Perceptible Interference Separation Distance
NONE	444'
1/2 shorted stub	62'
5/2 shorted stub	60'
Vitek 2 section	45'
5/4 open stub	23'
Vitek 3 section	12'

References

[1]R.W. Brandel, **Television Interference Associated With the Proposed Class E 220 MHz Citizens Radio Service,** Conference Record: 27th Annual Conference, IEEE-VTG, March 16, 1977.

[2]Federal Communications Commission, Personal Radio Planning Group, "Spectrum Alternatives for Personal Radio Services", FCC-OPP, April, 1977.

[3]Federal Communications Commission, Laboratory Division, **Interference to TV Channels 11 and 13 From Transmitter Operating at 216 to 225 MHz,** Project No. 2229-71, October 7, 1975.

POLES?
If You HAVE To Deal With Bell. . .
Here's Who To Deal With

Who To Contact?

Each year the Bell Telephone Company releases a listing of the individual people within its organization who are available as "contact" or "liason" people for CATV people with cable pole attachment "requests". What follows is the latest, revised, 1977 listing for these "liason representatives" to the cable television industry. If you are having contact problems, or wish to make a contact with one or more Bell (affiliate) company pole, find your area from those given and contact the individual listed.

BELL SYSTEM

ALABAMA
J. Ransom
South Central Bell
P.O. Box 405
Mountain Brook, Alabama 35223
205-877-5649

ARIZONA
V.L. Wood
Mountain Bell Telephone Co.
3033 N. 3rd Street
Phoenix, Arizona 85012
602-263-3433

ARKANSAS
L.D. Garner
Southwestern Bell Telephone
1111 W. Capitol-Room 624
Little Rock, Arkansas 72203
501-371-6144

CALIFORNIA
L.W. Hubert
Pacific Tel. & Tel. Co.
85 Second Street, Room 612
San Francisco, Calif. 94104
415-542-2851

COLORADO
Rudell Hughes
Mountain Bell Telephone Co.
P.O. Box 1976, Room 1130
Denver, Colorado 80201
303-624-6427

CONNECTICUT
Worth L. Cox
Southern New England Telephone Co.
130 Leeder Hill Road
Hamden, Connecticut 06517
203-771-2594

DELAWARE
David Y. Ball
Bell Tel. Co. of Pennsylvania
One Parkway
Philadelphia, Pa. 19102
215-466-3091

FLORIDA
(Northern)
R.E. Moore
Southern Bell Tel. & Tel. Co.
P.O. Box 390-400 Building-Room 621
Jacksonville, Florida 32202
904-353-2681

FLORIDA
(Southwestern)
C.E. Hanle
Southern Bell Tel. & Tel. Co.
6451 N. Federal Highway-Room 820
Ft. Lauderdale, Florida 33310
305-776-2788

(Southern)
J.W. Andrews
Southern Bell Tel. & Tel. Co.
666 NW 79 Ave-Room 542
P.O. Box 440100
Miami, Florida 33144
305-263-3911

GEORGIA
W.J. Hogan
Southern Bell Tel. & Tel. Co.
100 Perimeter Center Pl.-Room 210
Atlanta, Georgia 30346
404-391-4870

IDAHO
J.N. Freeman
Mountain Bell Telephone Co.
999 Main Street
Boise, Idaho 83701
208-385-2302

Paul E. Davis
Pacific Northwest Bell
Sixteen Hundred Bell Plaza, Room 2808
Seattle, Washington 98191
206-345-8550

ILLINOIS
L.A. Kemnitz
Illinois Bell Telephone Co.
225 Randolph St.-HQ 25B
Chicago, Illinois 60606
312-727-3336

INDIANA
R.T. McFeely
Indiana Bell Telephone Co.
220 N. Meridian Street, Room 1180
Indianapolis, Indiana 46204
317-265-7992

H.L. Wilson
Cincinnati Bell Inc.
225 E. 4th Street, Room 319
Cincinnati, Ohio 45202
513-397-2198

IOWA
R.D. Roe
Northwestern Bell Telephone Co.
10th & High Street
Des Moines, Iowa 50309
515-286-7287

KANSAS
Bob Pheasant
Southwestern Bell Telephone
220 E. 6th St-Room 340
Topeka, Kansas 66603
913-296-8881

KENTUCKY
Claude Smith
South Central Bell
600 South 7th Street
Louisville, Kentucky 40202
502-589-7634

H.L. Wilson
Cincinnati Bell Inc.
225 E. 4th Street, Room 319
Cincinnati, Ohio 45202
513-397-2198

LOUISIANA
D.R. Saucier
South Central Bell
1215 Prytania Street
New Orleans, Louisiana 70140
504-529-8996

MAINE
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave, Suite 1900
Boston, Massachusetts 02199
617-743-9473

MARYLAND
Paul E. McGinn
Ches. & Pot. Tel. Co. of Md.
222 St. Paul Place, Room 400
Baltimore, Maryland 21202
301-393-2665

MASSACHUSETTS
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave-Suite 1900
Boston, Massachusetts 02199
617-743-9473

MICHIGAN
W.F. Murray, Jr.
Michigan Bell Telephone Co.
27777 Franklin Road
A.M.C. Building-17th Floor
Southfield, Michigan 48076
313-424-1072

MINNESOTA
L.W. Erickson
Northwestern Bell Telephone Co.
224 South 5th Street, 16th Floor
Minneapolis, Minn. 55402
612-344-6623

MISSISSIPPI
Fred Miller
South Central Bell
1st National Bank Bldg-Room 935
Jackson, Mississippi 39201
601-948-2076

MISSOURI
(St. Louis Area)
J. Mullen
Southwestern Bell Telephone Co.
100 N. 12th Street-Room 559
St. Louis, Missouri 63101
314-247-4343

(Kansas City Area)
P.R. Bezner
Southwestern Bell Telephone Co.
500 East 8th St-Room 1094
Kansas City, Mo. 64106
816-275-8660

MONTANA
M.B. McGonigal
Mountain Bell Telephone Co.
560 N. Park Avenue
Helena, Montana 59601
406-449-2315

NEBRASKA
G.A. Christiansen
Northwestern Bell Telephone Co.
100 S. 19th Street
Omaha, Nebraska 68102
402-422-3628

NEVADA
Ed C. Trosi
Nevada Bell Telephone Co.
645 E. Plumb Lane-Room 143
Reno, Nevada 89510
702-789-6203

NEW HAMPSHIRE
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave-Room 1900
Boston, Massachusetts 02199
617-743-9473

NEW JERSEY
R.J. Legato
New Jersey Bell Telephone Co.
540 Broad Street-Room 1300
Newark, New Jersey 07101
201-649-3856

NEW MEXICO
Michael Canney
Mountain Bell Telephone Co.
201 Third Street
Alburquerque, New Mexico 87101
505-765-7073

NEW YORK
E.C. Engborg, Jr.
New York Telephone Co.
1250 Broadway-36th Floor
New York, N.Y. 10001
212-395-5443

NORTH CAROLINA
Dan J. Lawson
Southern Bell Tel. & Tel. Co.
P.O. Box 240-Fifth Floor, Southern National Center
Charlotte, N. Carolina 28201
704-377-8024

NORTH DAKOTA
G.L. Anderson
Northwestern Bell Telephone Co.
P.O. Box 1900
Fargo, N. Dakota 58102
701-235-3248

OHIO
James V. Fyfe
Ohio Bell Telephone Co.
1300 East 9th Street-Room 1929
Cleveland, Ohio 44114
216-822-3685

H.L. Wilson
Cincinnati Bell Inc.
225 E. 4th Street, Room 319
Cincinnati, Ohio 45202
513-397-2198

OKLAHOMA
R.E. Brogdon
Southwestern Bell Telephone Co.
621 N. Robinson-Room 101
Oklahoma City, Oklahoma 73126
405-236-7666

OREGON
J.W. DeYoung, Jr.
Pacific Northwest Bell
825 Northeast 20th Avenue
Portland, Oregon 97232
503-238-3002

PENNSYLVANIA
David Y. Ball
Bell Telephone Co. of Pennsylvania
One Parkway Bldg.
Philadelphia, Pa. 19102
215-466-3091

RHODE ISLAND
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave, Suite 1900
Boston, Massachusetts 02199
617-743-9473

RHODE ISLAND
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave, Suite 1900
Boston, Massachusetts 02199
617-743-9473

SOUTH CAROLINA
J.E. Sturdivant
Southern Bell Tel. & Tel. Co.
P.O. Box 752-612 1400 Bldg.
Columbia, S. Carolina 29202
803-799-1767

SOUTH DAKOTA
R.L. Hicks
Northwestern Bell Telephone Co.
125 So. Dakota Avenue
Sioux Falls, South Dakota 57102
605-339-5908

TENNESSEE
S.P. Hamilton
South Central Bell
Suite 221 Century Plaza Bldg.
2000 Richard Jones Road
P.O. Box 10
Nashville, Tennessee 37202
615-298-7354

TEXAS
(El Paso)
G.E. Palmore
Mountain Bell Telephone Co.
214 N. Stanton
El Paso, Texas 79999
915-543-4433

(Dallas Area)
Glen Wamble
Southwestern Bell Telephone Co.
308 S. Akard Street-Room 1519
Dallas, Texas 75202
214-745-2253

(Houston Area)
W.G. Hole
Southwestern Bell Telephone Co.
P.O. Box 1530, Room 704
Houston, Texas 77001
713-521-7941

(San Antonio Area)
Kenneth King
Southwestern Bell Telephone Co.
1010 North St. Mary's-Room 1006
San Antonio, Texas 78206
512-222-3949

UTAH
C.A. Gibson
Mountain Bell Telephone Co.
80 S. 3rd East Street
Salt Lake City, Utah 84111
801-524-6564

VERMONT
J.E. Douglas
New England Tel. & Tel. Co.
101 Huntington Ave, Suite 1900
Boston, Massachusetts 02199
617-743-9473

VIRGINIA
Reuben Burton, Jr.
Ches. & Pot. Tel. Co. of Va.
10 North 9th Street
Richmond, Virginia 23219
804-772-3512

WASHINGTON
Paul E. Davis
Pacific Northwest Bell
Sixteen Hundred Bell Plaza, Room 2808
Seattle, Washington 98191
206-345-8550

WEST VIRGINIA
Allison B. Galliher
Ches. & Pot. Co. of W. Va.
1500 MacCorkle Ave, SE-Room 318
Charleston, W. Va. 25314
304-344-6684

WISCONSIN
R.A. Sanders
Wisconsin Telephone Co.
324 E. Wisconsin Ave-11th Floor
Milwaukee, Wisconsin 53202
414-678-2060

WYOMING
D.R. Humphreys
Mountain Bell Telephone Co.
2020 Capital Avenue
Cheyenne, Wyoming 82001
307-634-2590

DISTRICT OF COLUMBIA
James E. Anderson
Ches. & Pot. Tel. Co.
935 V. Street N.E.
Washington, D.C. 20018
202-392-5664

CANADIAN CARS BAND CHANGES

The Department of Communications (DOC) licensing policy for the 12.7 to 12.95 GHz (Canadian short haul) CARS type microwave band is scheduled for a change in the not to distant future. At the present time Hughes AML type equipment is being rather widely employed in Canada, as it is in the United States, for point to point relay of CATV system signals. **Rumor** has it that the AML gear will **not** be available for the new frequency allocation; which sort of leaves the Canadian users of short haul microwave scratching their heads wondering who will supply the gear for a frequency band which is not presently shared with the larger volume users in the United States, or anywhere else in the world.

The **official** word on the Canadian policy for changing out of the 12.7/12.95 GHz band is as follows:

"In the July 14, 1976 issue of the DOC policy, the cut-off date for 12 GHz equipment was specified as January 1, 1978; to apply for a license in the present band. This date was determined by the expected availability of 15 GHz (the new band) equipment and the release of the (final) 15 GHz policy. Both the development of 15 GHz equipment and the release of the policy have been delayed. It is now anticipated that a cut-off date later than January 1, 1978 will apply to the granting of new licenses for the 12 GHz equipment."

So when, after January 1, 1978, will the DOC imposed cut-off date for licensing new 12 GHz systems go into effect? It could come at the conclusion of phases I, II or III of RSP 113, or some intermediate point within a phase. In any event, the availability of 15 GHz equipment **will** enter into the decision.

CATJ has asked Microwave Associates (with their new 12 GHz Gunnplexer/Microplexer equipment) if they might make the new "plexer" gear available for the Canadian 15 GHz band and we learned that 'yes' it was actively being considered. We will keep members of the industry advised.

C-COR TECHNICAL SEMINARS

C-COR Electronics, Inc. has scheduled a pair of State College, Pa. technical seminars for CATV engineers and technicians which will feature technical presentations and hands-on demonstrations. Distribution system design, calculation and measurements, lightning, and surge protection, system reliability and level control are included in the two day sessions. The dates are September 22-23 and October 27-28. For full information contact James R. Palmer at C-COR Electronics, Inc., 60 Decibel Road, State College, PA. 16801 (814/238-2461).

JERROLD MATV/CATV TECH SCHOOLS

Jerrold Electronics has announced the schedule and tuition rate fee schedule for their 1977/78 MATV and CATV tech school "year". These are three-day "hands-on" sessions, now heading for their twenty-fifth year of service to the industry. Len Ecker conducts the CATV Tech School sessions and the tuition rate is $95 per man (or woman) registered; Helmut Hess handles the MATV area sessions and the registration is $65 for this series of classes.

The schedule for the Tech Schools for the coming "year" is as follows:

CATV

Keene, New Hampshire
September 27-29, 1977

Kansas City, Mo.
November 15, 17, 1977

Atlanta, Georgia
January 15-17, 1978

Portland, Oregon
May 23-25, 1978

MATV

Philadelphia, Pa
September 26-28, 1977

Chicago, Illinois
October 11-13, 1977

Atlanta, Georgia
November 1-3, 1977

Los Angeles, California
December 6-8, 1977

Washington, D.C.
January 10-12, 1978

Dallas, Texas
February 7-9, 1978

Boston, Massachusetts
March 14-16, 1978

Portland, Oregon
April 3-5, 1978

Columbus, Ohio
May 23-25, 1978

Kansas City, Missouri
June 6-8, 1978

For additional information and registration forms contact Jerrold Electronics, P.O. Box 487, Byberry Road and PA Turnpike, Hatboro, Pa. 19040.

Finding Swan

"In your March issue you carried an article on serving rural areas cheaply, including alot of information on some small CATV systems set up by Oliver Swan (see page 10, March, CATJ). As I spend winters in Mesa, Arizona I would very much like to meet Mr. Swan and would appreciate his address. I am the former owner of Central TV Systems in Revelstoke, B.C.; you may recall preparing an article describing my system in a 1960 issue of **DXing Horizons;** a partial reprint of that article appeared in CATJ last summer."

C.E. Stephens
Oliver, B.C., Canada

Mr. Stephens—

Only the real old timers in this business recall your early pioneering work with knife-edge refraction in British Columbia in the 50's; we happen to remember not only your work but the extra-ordinary results you achieved! Oliver Swan is your kind of pioneer. He can be contacted at Swan Antenna Company, Box 5378, Bisbee, Arizona 85603 (602/432-5526). **CCOS attendees in Oklahoma this past July were treated to some of the "Swan Magic" as Oliver explained to a packed room how to make saleable pictures out of off-air signals that measured lower than 10 microvolts on a dipole.**

Low Cost Microwave

"I was very pleased to read about the low cost microwave package. We have a situation here in Batesville where we will be serving, through a separate head end, a potential of six or seven hundred subscribers only about two miles from the head end. The two locations are separated by the White River and the only practical method of connecting them is via microwave. If and when we add the independent channel 17 (WTCG) signal to our Batesville system, the microwave described in CATJ is a natural for this situation. We also have a rather large investment in a pair of MSI channels and this low cost microwave approach would enable this second, smaller system to enjoy these additional services that would otherwise not be available to them."

Jim E. Davidson
DAVCO Electronics Corp.
Batesville, Arkansas

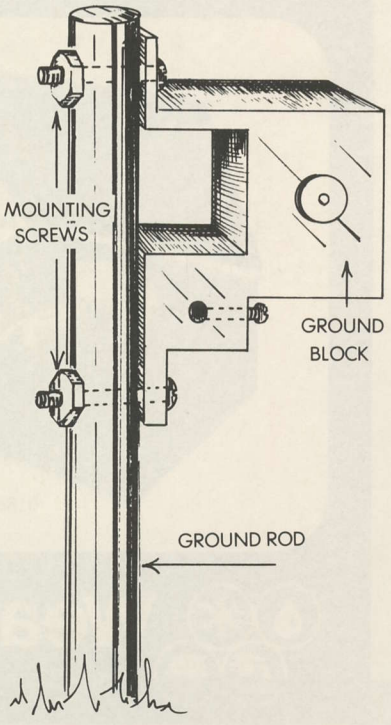
Good Ground

"Here is a design of a simple to apply grounding technique we have developed for CATV drops. It is simplicity itself, and because several states (New York for one) have recently required that all CATV systems therein operating provide grounded entry to CATV drops, this may be a cost effective solution to the problem. We take a four foot ground rod and drill it for two 6-32 screws as shown. A grounding block, such as the Magnavox CGB-3 is attached to the ground rod as shown. This takes care of grounding when the rod is driven into the soil and it makes a convenient dis-connect point when a trailer or mobile home is moved. I would not advise disconnecting on the ground end however for normal drops; it is too easy for someone to add a jumper of 59 and get service back without paying for it!"

J. J. Mueller
EMCO CATV
Manchester, Vermont

TECHNICAL TOPICS

EMCO's grounding block as described.



CATA ASSOCIATES

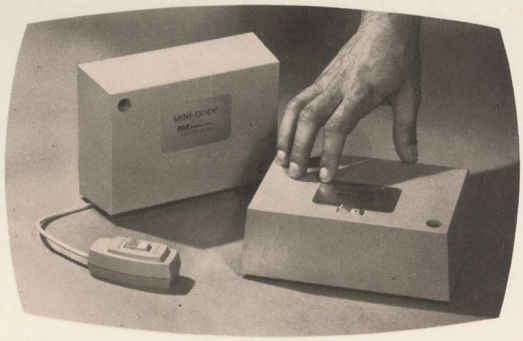
In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry,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

AEL, INC., CATV COMMUNICATIONS DIV., P.O. Box 552, Lansdale, PA 19446, **(M1, S2)** 215-822-2929
Andrew Corp., 10500 W. 153rd St., Orland Park, IL. 60462 (**M2, M3, M9** Satellite Terminals) 312—349-3300
Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 (**D1**) 206—624-0505
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**) 408—249-0700
Belden Corp., Electronic Division, Box 1327, Richmond, IN. 47374 (**M3**) 317—966-6661
BESTON ELECTRONICS, INC. 903 South Kansas Ave., Olathe, KS. 66061 (**M9**) Character Generators-913-764-1900
BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 (**M1, M2, M4, M5, M6, M7**) 201—679-4000
BROADBAND ENGINEERING, INC., 535 E. Indiantown Rd., Jupiter, FL. 33458 (**D9, replacement parts**) 305-747-5000
CALIFORNIA MICROWAVE, INC., 455 West Maude Ave., Sunnyvale, CA. 94086 (**M9 Satellite Terminals**) 408—732-4000
CATEL, 1400-D Stierlin Rd., Mt. View, CA 95043, **(M4, M9)** 415-969-9400
CCS HATFIELD/CATV DIV. 5707 W. Buckeye Rd., Phoenix, AZ. 85063 (**M3**) 201—272-3850
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA. 16801 (**M1, M4, M5, S1, S2, S8**) 814—238-2461
COLLINS COMMERCIAL TELECOMMUNICATIONS, MP-402-101, Dallas, TX 75207, **(M9, Microwave)** 214-690-5954
COMMUNICATION EQUITY ASSOCIATES, 8200 Normandale Blvd., Suite 323, Bloomington, MN. 55435 (**S3**) 612—831-4522
COMM/SCOPE COMPANY, Rt. 1 Box 199A, Catawba, NC 28609, (**M3**) 704-241-3142
ComSonics, Inc., P.O. Box 1106, Harrisonburg, VA. 22801 (**M8, M9, S8, S9**) 703—434-5965
C R C ELECTRONICS, INC., P.O. Box 855, Waianae, HI 96792, (**M9** Videotape Automation Equipment) 808-668-1227
DAVCO, INC., P.O. Box 861, Batesville, AR. 72501 (**D1, S1, S2, S8**) 501—793-3816
EAGLE COM-TRONICS, INC., 8016 Chatham Dr., Manlius, N.Y. 13104 (**M9 Pay TV Delivery systems & products**) 315—682-2650
EALES COMM, & ANTENNA SERV., 2904 N.W. 23rd, Oklahoma City, OK 73107, **(D1,2,3,4,5,6,7, S1,2, S7,8)** 405-946-3788
FARINON ELECTRIC, 1691 Bayport, San Carlos, CA. 94070 (**M9, S9**) 415—592-4120
FEDERAL BROADCASTING CO. 600 Fire Rd. Box 679 Pleasantville, N.J. 08232 **(D9, S9)**
FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX. 75652 **(S1, S2, S7, S8, S9)** 214—854-2405
FRANK L. CROSS & ASSOCIATES, INC., 5134 Melboune Dr., Cypress, CA 90630, **(M9)** 714-827-0868
GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ. 85063 (**M7**) 602—272-6871
G T E SYLVANIA, 3046 Covington Rd., Marietta, GA 30062, (**M1,D1**) 404-003-1510
HOME BOX OFFICE, INC., 7839 Churchill Way—Suite 133, Box 63, Dallas, TX 75251 (**S4**) 214—387-8557
ITT SPACE COMMUNICATIONS. INC.. 69 Spring St., Ramsey, N.J. 07446 (**M9**) 201—825-1600
JERROLD Electronics Corp ., P.O. BOX 487, Byberry Rd. & PA. Turnpike, Hatboro, PA 19040, **(M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8)** 215-674-4800
JERRY CONN ASSOCIATES, INC., P. O. Box 444, Chambersburg, PA 17201 **(D3, D4, D5, D6, D7, D8)** 717-263-8258
LARSON ELECTRONICS, 311 S. Locust St., Denton, TX. 76201 (**M9 Standby Power**) 817—387-0002
LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 (**M7**) 607—739-3844
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 (**M1**) 315—682-9105
MICROWAVE ASSOCIATES, INC. 10920 Ambassador Drive-Suite 119 Kansas City, MO. 64153 (**M9**) Microwave Radio Systems-816-891-8895
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 13057 (**M5, bandpass filters**) 315—437-4529
MID STATE Communication, Inc. P.O. Box 203, Beech Grove, IN. 46107 (**M8**) 317-787-9426
MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 (**M9 Digital Video Equip.**) 801—262-8475
NORTHERN CATV DISTRIBUTORS, INC., 8016 Chatham Dr., Manlius, N.Y. 13104 (**D1**) 315—682-2670
OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL. 60014 (**M1, M9 Converters, S3**) 815—459-5000
PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA. 95050 (**M2, M3, M7, S2**) 408—244-4720
Q-BIT Corporation, P.O. Box 2208, Melbourne, FL. 32901 (**M4**) 305—727-1838
RADIO MECHANICAL STRUCTURES, INC., P.O. Box 1277, Kilgore, TX 75662 **(M2, M9, S2)** 214-984-0555
R F SYSTEMS, INC., P.O. Box 428, St. Cloud, FL 32769, **(M2, M6)**, 305-892-6111
RICHEY DEVELOPMENT CORP., 1436 S.W. 44th, Oklahoma City, OK. 73119 (**M1, M4, M8, S8**) 405—681-5343
RMS CATV Division, 50 Antin Place, Bronx, N.Y. 10462 (**M5, M7**) 212—892-1000
Sadelco, Inc., 299 Park Avenue, Weehawken, N.J. 07087 (**M8**) 201—866-0912
Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA. 30340 (**M1, M2, M4, M8, S1, S2, S3, S8**) 404—449-2000
SCIENTIFIC COMMUNICATIONS, INC., 3425 Kingsley Rd., Garland, TX 75041, **(M4 Low Noise & Parametric)** 214-271-3685
SITCO Antennas, P.O. Box 20456, Portland, OR. 97220 (**D2, D3, D4, D5, D6, D7, D9, M2, M4, M5, M6, M9**) 503—253-2000
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ. 85036 (**M3**) 602—268-8744
TERRACOM, 9020 Balboa Ave., San Diego, CA 92123, **(M9 Microwave Earth Stations)** 714-278-4100
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 (**M8, bandpass filters**) 317—357-8781
Theta-Com, P.O. Box 9728, Phoenix, AZ. 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML MICROWAVE**) 602—944-4411
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**) 203—265-2361
Titsch Publishing, Inc., P.O. Box 4305, Denver, CO. 80204 (**S6**) 303--573-1433
Tocom, Inc., P.O. Box 47066, Dallas, TX. 75247 (**M1, M4, M5, Converters**) 214—438-7691
TOMCO COMMUNICATIONS, INC., 1077 Independence Ave., Mtn. View, CA 94043 (**M4, M5, M9**) 415-969-3042
Toner Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA. 19044 (**D2, D3, D4, D5, D6, D7**) 215—675-2053
Triple Crown Electronics Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W2Z3 **(M4,M8)** 416 743-1481
UNITED PRESS INTERNATIONAL, 220 East 42nd St., New York, N.Y. 10017, (**S9**) (Automated News Svc.) 212-682-0400
UNITED STATES TOWER & FAB. CO. P.O. Drawer "S", Afton, OK 74331 **(M2,M9)** 918-257-4257
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, automated ladder equipment**) 712—262-5810
VIDEO DATA SYSTEMS, 40 Oser Avenue, Hauppauge, N.Y. 11787 (M9) 516-231-4400
VITEK ELECTRONICS, INC., 200 Wood Ave., Middlesex, N.J. 201—469-9400
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**) 317—783-3221
WEATHERSCAN, Loop 132 - Throckmorton Hwy., Olney, TX. 76374 (**D9, Sony Equip. Dist., M9 Weather Channel Displays**) 817—564-5688
Western Communication Service, Box 347, San Angelo, TX. 76901 (**M2, Towers**) 915—655-6262/653-3363

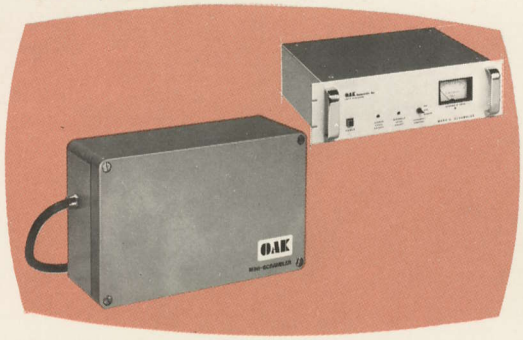
NOTE: Associates listed in bold face are Charter Members

OAK PRESENTS THE MINI-CODE NEWS

Oak CATV Division has announced the new Mini-Code—an effective and economical answer to CATV and MDS premium needs.



This technologically advanced decoder, offered in set-top or wall-mount format, works in your existing 12-channel or MDS system.



Use it in tandem with the Oak Mini-Scrambler, at a remote site, or with the Mark II Scrambler at the head-end.

The Oak sinewave sync suppression system is impossible to defeat.

SOURCE	CBS	PREMIUM	NBC	PBS
CHANNEL	2	3	4	5

Best of all, the Mini-Code uses only one channel to scramble and decode.

When you buy from Oak, you rest easy, because you know Oak products are manufactured in company-owned facilities. Oak backs up its products with effective field service, and offers all customers a one-year warranty.

FOR THE COMPLETE MINI-CODE STORY, CALL OR WRITE

OAK Industries Inc.

CATV DIVISION

CRYSTAL LAKE, ILLINOIS 60014

TELEPHONE: 815-459-5000 TWX: 910-934-3332

Coming through...

with performance — where it counts

Time is money. And installation time adds up fast. At Belden, we're coming through with ways to save you time and money on every job.

DUOBOND®

The drop cable that makes fast, profitable connections, time after time. Its aluminum foil shield is bonded directly to the core—doesn't push back when "F" connectors are installed. Cuts way down on signal leakage, call-backs and troubleshooting problems.

UNREEL®

Dramatically slashes installation time—up to 50%! It feeds wire freely, right from the carton with no kinks, backlash or reels.

We've got a lot more going for you, from fast delivery to complete technical information.

SEED® (Shielding Effectiveness Evaluation Device), for instance. This revolutionary testing system makes cable selection easier and far more accurate than previously possible.

Our new comprehensive guide to CATV coax cable makes selection easy, too. Has answers to a wide range of needs. Send for your copy today!

Make sure you contact Belden for all your CATV drop cable needs. We'll come through with answers that insure optimum performance. Where it counts. Belden Corporation, Electronic Division, P.O. Box 1327, Richmond, IN 47374; 317-966-6661. 8-3-7

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with new ideas for moving electrical energy