Technical Session 1, held in the Adams Room of the Palmer House, Chicago, Illinois, convened at nine o'clock, a.m., Mr. Charles Clements, CATV Consultant, Waterville, Washington, presiding.

CHAIRMAN CLEMENTS: The Technical Session will be in order.

We will split into three groups, so that we have six different topics to cover within the next two hours and fifty minutes.

Our first item on the agenda is MATV TECHNIQUES FOR CATV OPERATORS, by Fred Schulz of Blonder-Tongue Laboratories, Inc.

MANUSCRIPT FOR PRINTED RECORD
MATV TECHNIQUES FOR THE CATV OPERATOR

BY:
Fred J. Schulz

CATV operators deliver their signals, in most cases, to individual subscribers, through individual drop lines; however, almost all systems serve hotels, motels, apartment houses and similar multiple dwellings. Today, virtually all new large buildings in metropolitan areas have Master Antenna TV (MATV) systems. It is the purpose of this paper to disseminate the experiences and techniques used in the MATV industry.

An MATV system, as well as a CATV system, consists of three major sections:

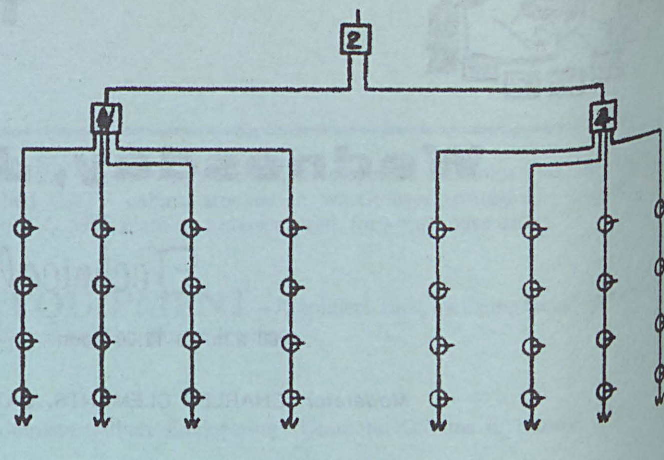
1. Signal pickup (antennas).
2. Signal processing, amplification and mixing (HE gear).
3. Signal distribution.

In our case, all TV signals are delivered to the MATV system already mixed and equalized from a CATV drop and we, therefore, need to concern ourselves only with the distribution system and the necessary amplification.

MATV distribution system are, wherever possible, arranged to avoid use of reamplification within the system.

The usual way signals are distributed is by using so called RISERS or BRANCH lines into which tapoffs are inserted at each TV set location. The risers in turn are connected together with a number of splitters. Such an arrangement looks like the drawing shown.

It is desirable to limit the number of tapoffs per riser to 15 to keep reflections to a low value.



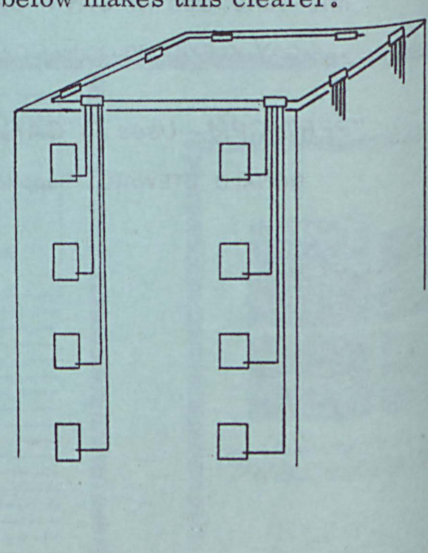
We not must look at the building in which we wish to install a distribution system and decide where we can run the risers most efficiently, as well as for a suitable place for the amplifiers. Two most commonly encountered structures are:

A. Tall buildings, for which vertical risers are most suitable. Risers may, for instance, be run in utility shafts.

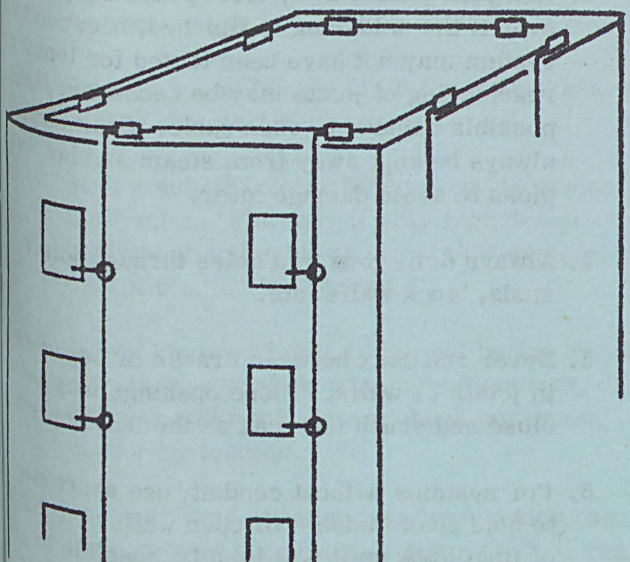
B. Long buildings, such as motels, for which horizontal risers (or branch lines) are most suitable.

A separate TV conduit system should be installed in all new buildings.

In existing structures it is often not possible to use wiring inside the building. A cable run along the top periphery of the building with periodically-inserted, multiple tapoffs and individual drop cables to each apartment can be used in such a case. The illustration below makes this clearer.



For existing tall structures one may use a series of 2 or 4-way, or asymmetrical splitters on top of the building with drop lines down the outside walls and pressure taps located just outside of each apartment. See illustration below:



For small installations, it is also possible to run a series of splitters with individual lines to each tenant's TV set.

There are a great variety of MATV tapoffs available, such as:

A. Surface mounted types for existing buildings.

B. Flush mounted types (usually fit into GEM boxes).

C. Multiple output types.

D. 75 ohm output types.

E. 300 ohm output types.

F. Pressure taps.

Manufacturer's MATV catalogs are a good source for detailed tapoff information. The key electrical characteristics are, as in CATV taps:

A. Isolation (typically 12, 17, 23dB).

B. Thru loss (typically 0.7 dB for a 17 dB resistive isolation tap).

It should be noted that it is not necessary to terminate unused tapoff outputs; risers however must all be terminated.

ELECTRICAL DESIGN OF THE SYSTEM

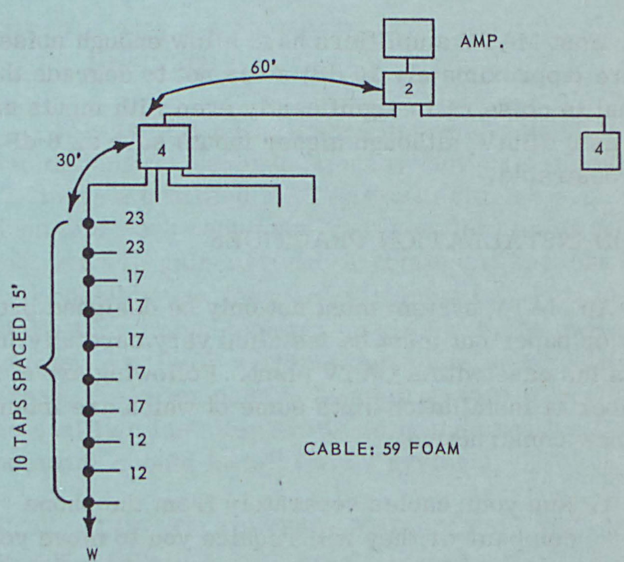
After it is decided on how to run the risers and where to place splitters and amplifiers, one must make a systems loss computation.

Losses should be computed for channel 13 and for the longest riser, with a double check on channel 2 for the shortest one (maximum tolerable signal level to TV set). The losses to be added are (from furthest TV set to amplifier):

1. Matching transformer loss.
2. Tapoff isolation value.
3. Thru loss of all taps on the particular riser.
4. Cable losses.
5. Splitter losses.

It is customary to use graded isolation on the taps just as is done in CATV taps. The last three taps on a riser are usually 12 dB. The next ones (approximately 5) are 17 dB with the remainder 23 dB types. RG-59/U or 59 type foam cables are usually used in MATV systems. If pressure taps are employed one is forced to go to RG-11 type cable because there are no pressure taps for RG-59 type cable available.

Let us look at a sample system and its loss computation:



The losses for the longest riser are:

Matching xformer		0.5 dB
Tapoff isolation		12.0 dB
Thru loss:	three 12 db taps @ 1.2 dB	3.6 dB
	five 17 dB taps @ 0.7 dB	3.5 dB
	two 23 dB taps @ 0.4 dB	0.8 dB
Cable length 9 x 15' + 30' + 60' - 225' @ 4 dB/100'		9.0 dB
One 4-way splitter		6.5 dB
One 2-way splitter		3.5 dB
Total distribution loss		39.4 dB

In case all tapoffs are spaced equally (as was the case in our example), one may use a precomputed riser diagram, as a sample of which is attached.

The required amplifier output is simply -

Amplifier output = distribution loss + desired signal level at TV set.

The signal level at the TV set should be the same as is used for individual CATV drops, namely 0 to +6 dBmV (except for areas where local pickup is a problem and move than 6 dBmV may be needed).

The required gain of the amplifier is the difference between the required output level and the level fed into it from the CATV system.

Assuming we decide to supply 0 dBmV to the TV sets and provide +6 dBmV from a CATV drop, our amplifier must have the following characteristics:

Output capability = 39.4 dB (distr. loss) plus 0 dBmV at the last set

= 39.4 dBmV

Gain = 39.4 dBmV minus 6 dBmV input level

= 33.4 dB

Most MATV amplifiers have a low enough noise figure (approximately 10 dB) so as not to degrade the signal to noise ratio significantly even with inputs as low as 0 dBmV, although higher inputs such as 6 dBmV are desirable.

GOOD INSTALLATION PRACTICES

An MATV system must not only be designed properly on paper but must be installed very carefully just as is the case with a CATV plant. Following are a number of installation hints some of which are intended for new construction.

1. Run your cables separately from the phone company or they will require you to move your cables before providing service.

2. Run your cables separately from the electrical wiring because the electrician may damage your coax cable while pulling his heavier cables.

3. Run your cables away from plumbing pipes, even if the soldering is finished, because the system may not have been tested for leaks and resoldering of joints may be necessary, with possible damage to coax cable. Coax should always be kept away from steam and hot water pipes to avoid damage later.

4. Always drill your own holes through joists, studs, block walls, etc.

5. Never run coax between cracks or separations in joists or walls. These openings may later close and crush the coax as the building settles.

6. For systems without conduit, use short staples to hold coax inside still open walls. At the time of final hook up it will then be possible to pull slack as the short staples can be pulled out.

7. Install 2" deep ROMEX GEM boxes wherever tapoffs are required. Set the depth of the boxes from the stud to be slightly less than the thickness of the sheet rock or wet walls. GEM boxes should be mounted 18" on center from finished floor.

8. Local and national electric codes must be followed.

9. Leave approximately 6" to 8" of coax cable at each box for connecting the tapoff. Coil this slack into the GEM box. Gently tighten cable clamp. Tapoffs will be installed after the walls are finished.

10. When installing the tapoffs remove the BX cable clamps to provide more space in the box. Install cover plates after walls are painted.

11. Be careful to terminate each and every riser, (usually explained on the tapoff instruction sheets).

12. Determine easiest and/or shortest way to run coax. Install coax to tapoffs as predetermined in drawings and calculations.

THE MATV INSTALLER AS CONTRACTOR

In new construction, its customary that the MATV system is part of the electrical contract. In this case, the MATV installer is a subcontractor to the electrical contractor. Listed below are a number of points to be aware of:

1. Written specs for the MATV installation are part of the electrical contract.

2. MATV subcontractor bids to the electrical contractor. This bid usually includes all equipment and cable in the MATV system, except the "GEM" boxes.

3. Labor included in the bid would be for hookup, drawings, wiring diagrams, engineering, deliveries and final system check out by the MATV contractor.

4. The MATV contractor usually provides one year system guarantee to the electrical contractor, who in turn guarantees the system to the owner.

5. All correspondence with the architect, electrical engineering firm, or the owner is handled through the electrical contractor.

6. A "submission" consisting of "cuts" (spec sheets) of the equipment to be supplied, and a wiring diagram of the proposed system is submitted to the electrical contractor by the MATV contractor. The electrical contractor in turn submits this, under this cover letter, for approval to the architect.

7. Electrical contractor furnishes all (roughing) labor up to Head-End connections and final check out.

8. MATV sub-contractor must instruct electrical contractor's personnel in the proper method and handling of all associated MATV equipment, (supply equipment-instruction sheets and drawings if necessary).

9. Obtain from electrical contractor a copy of work schedule with equipment delivery dates listed.

10. Final checkout and acceptance of system to be arranged with electrical contractor in accordance with specifications.

In some cases, the MATV installer is the prime contractor to the owner. Here are a few hints for such an arrangement.

1. MATV contractor supplies all equipment, cable and labor directly to owner.

2. Establish in writing with the owner, the method and location of all associated phases of the installation. Verify working hours available. Establish (with the owner) who will furnish electrical power to the headend location. Obtain permission for storage area on job site while installation is in progress.

3. One year guarantee and service contract to commence from date of final checkout and acceptance of system by owner. Prepare a renewal contract in advance.

COST OF MATV INSTALLATIONS

Many people feel that a magic per outlet cost is available to compute the price of an MATV installation, this unfortunately is not so. Nobody knows better than the CATV installer that the cost of running a drop line to a TV set is not at all constant and that it depends a great deal on the local conditions. The old fashioned method of using a cost sheet where individual labor estimates for cable installation, tapoff installation, hook-up time, check out time and material cost are made in an orderly fashion is still the best way to quote an installation at a fair price and profit.

It is particularly important to keep records of actual expenditures so future job quotes can be adjusted accordingly.

SHOULD THE CATV OPERATOR ENTER THE MATV BUSINESS?

This is of course, a very important question and the answer depends on many factors such as: "Is there a qualified MATV installer in the area who does this work regularly"? If yes, let him do the job, you will gain a friend or retain one because he will possibly use your CATV signals in future installations rather than put up a HE with its own antennas. As CATV systems move into metropolitan areas, the latter case is becoming more likely. If no qualified installer available in the area the CATV operator should install MATV systems.

HOW MUCH TO CHARGE FOR MATV SYSTEM HOOK-UPS?

The best arrangement for the CATV operator is to make a deal with the apartment house owner, this will save collection cost and provide a nice lumped sum income. A tennant used to multichannel TV service is also likely to stay your customer should be later buy his own home in the community. People moving into a community for a new job and newlyweds fall into this category.

For motels, a reduced rate of approximately 1/2 the regular home subscription rate is quite common.

Hsopitals, convalescent homes etc. are different from apartment houses. One might find it desirable to donate an installation as a public relations good will gift. At least one operator put a system into a community senior citizen home at cost and charged full rates for a number of outlets donating the service for all others. Renting TV service to hospital patients can bring extra revenue to the CATV operator and the hospital.

Obviously there is not enough time to go into all details of MATV techniques; MATV product manufacturers are however more than happy to furnish additional information.

In conclusion, let me say that MATV installations are a natural extension of CATV service and the CATV operator should make it his business to be familiar with this field.

CHAIRMAN CLEMENTS: Thank you, Fred.

I am sure that many of us are being faced with this situation right now, on the wiring of apartment houses, which is an entirely new phase to me. I am aware that Lennie Cohen in New York has this real problem, and I know that others have, also.

If there are any questions of Fred, he is available to answer them.

DR. LEON RIEBMAN (American Electronics Laboratories, Inc.): I have a question. What is the status of UHF and MATV?

MR. SCHULZ: Equipment is available for UHF distriction in MATV systems. Blonder-Tongue has made this equipment available for a number of years, and so have other manufacturers.

The basic limitations are the higher cable losses of UHF reamplification in large UHF distribution systems may be needed. The equipment is available, and in fact we are recommending that all systems being installed in buildings be UHF-VHF distribution systems, even if UHF channels are not in the area at this moment, or if not all channels will be used on VHF; or, where conversion could be used, because conversions, as a rule, bring problems with them.

"Putting in UFH-VHF distribution systems might become very important for CATV and MATV systems, because once you have 20 channel systems, the additional channels may be moved up to the UHF band.

FROM THE FLOOR: In CATV systems we are somewhat concerned about how much signal level to put on 59/u cables. One of the things we have noticed in these distribution systems is that amplifiers go out at 40 dBmV and are going into single shield coaxial cable, and I believe they do radiate and create problems.

Is there any consideration of this at the moment?

MR. SCHULZ: Many installations in MATV are made with cable of the 59 type. We have found that rather than the radiation problem being one, it is conversely the local pickup, which is the problem and to solve it you may have to go to double-shielded cable. The installation techniques are very important. You do have to provide good grounding of equipment, possibly putting amplifiers in radiation enclosures, with proper feed throughs so there is a minimum of signal going on the outside of the cable.

FROM THE FLOOR: What I was primarily concerned with, the FCC regulations indicate that you should not radiate more than a specified value from a meter on any coaxial cable, and putting the 40 dBmB on the 59 cable would apparently violate the regulations. I have recently been involved with some systems, and my approach is that it seems to me with CATV design system, using the double-shielded cable, using hybrid couplers, et cetera, it becomes very costly as a process for doing it.

I cannot, however, think of another way to do it and still remain within the FCC requirements.

MR. SCHULZ: In many MATV systems you have the conduit system which acts as an additional shield. When you go into existing buildings you might have to go to double-shielded cable for a portion where the signal levels are high until you come to the splitters. You might have to use aluminum cable up to that point if radiation is a problem.

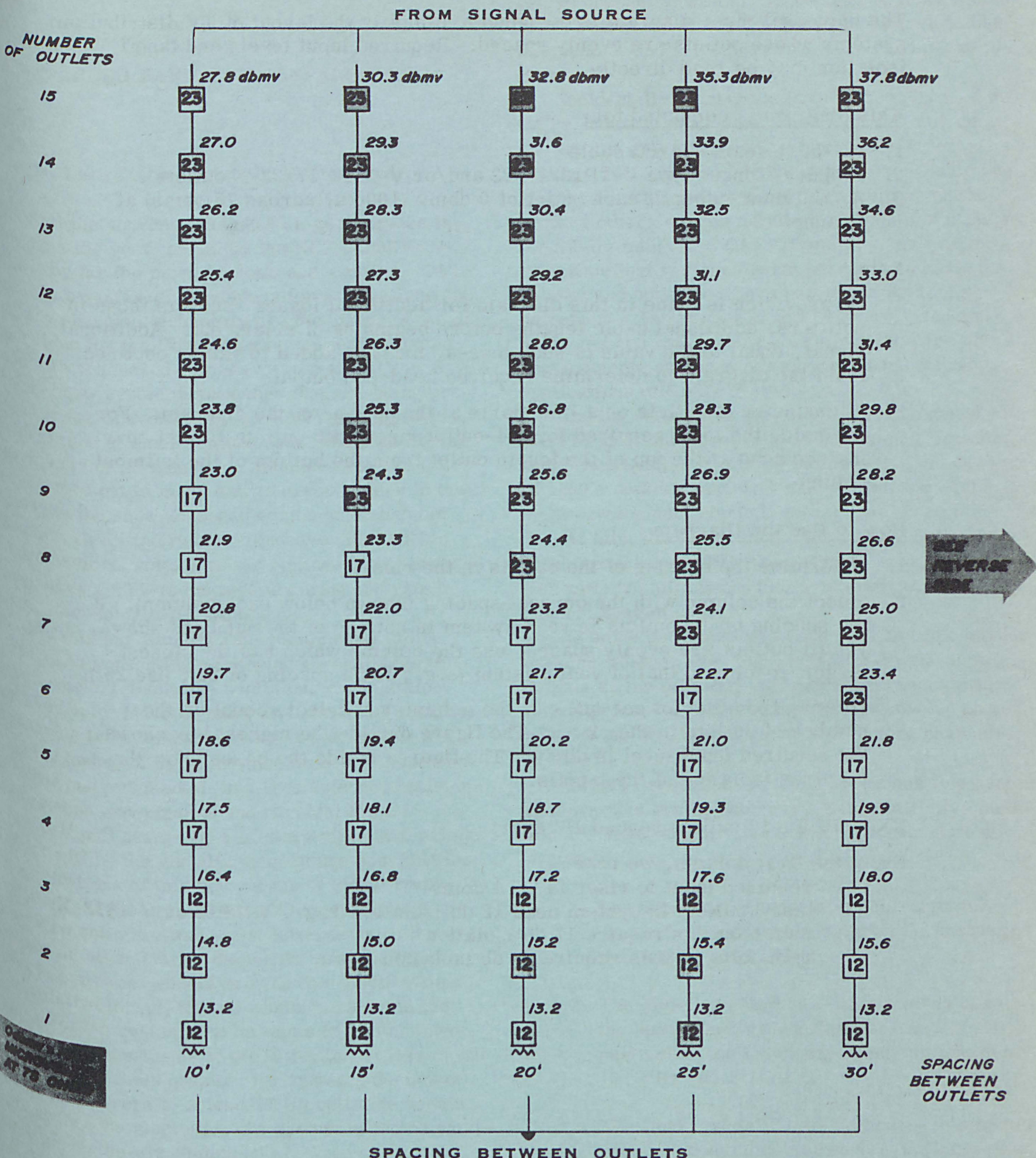
CHAIRMAN CLEMENTS: Are there any other questions of Fred Schulz? As I understand it there are copies of his manuscript in the rear of the room.

We will vary our agenda somewhat at this point, and ask Dr. Leon Riebman, of American Electronics Laboratories, Inc., to address us on the subject of EXPANDED BAND CATV CAPABILITIES.

Dr. Riebman.

DR. REIBMAN: Thank you, Mr. Chairman.

It is a pleasure for me to have the opportunity to present this joint paper prepared by Walter Wydro, my colleague at AEL, and myself, on a subject that is still in a rapidly-changing environment. There is still a great deal of flux going on in the business of


FROM SIGNAL SOURCE
NUMBER OF OUTLETS
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
27.8 dbmv
27.0
26.2
25.4
24.6
23.8
23.0
21.9
20.8
19.7
18.6
17.5
16.4
14.8
13.2
10'
30.3 dbmv
29.3
28.3
27.3
26.3
25.3
24.3
23.3
22.0
20.7
19.4
18.1
16.8
15.0
13.2
15'
32.8 dbmv
31.6
30.4
29.2
28.0
26.8
25.6
24.4
23.2
21.7
20.2
18.7
17.2
15.2
13.2
20'
35.3 dbmv
33.9
32.5
31.1
29.7
28.3
26.9
25.5
24.1
22.7
21.0
19.3
17.6
15.4
13.2
25'
37.8 dbmv
36.2
34.6
33.0
31.4
29.8
28.2
26.6
25.0
23.4
21.8
19.9
18.0
15.6
13.2
30'
REVERSE
SPACING BETWEEN OUTLETS
SPACING BETWEEN OUTLETS

The universal riser diagram is designed to simplify the layout of TV distribution systems whose outlets are evenly spaced. Required input levels and tapoff isolation may be read directly.

This diagram is computed for:

1. RG-59/U foam coaxial cable
2. Blonder-Tongue type V-1P12/17/23 and/or V-1S12/17/23-X outlets
3. A minimum output at each outlet of 0 dbmv (1000 uv across 75 ohms) at Channel 13

Notes

1. No provision is made in this diagram for additional losses, such as those in splitters, additional cable lengths before beginning of riser, etc. Additional signal, equal to the value of such losses, must be added to values obtained from the diagram to determine required head-end output.
2. The number of outlets on a line starts at the bottom of the diagram. For example, the level required for a 4-outlet riser with outlets 10 feet apart may be read at the top of the fourth outlet from the bottom of the leftmost column.

How to Use the Diagram

1. Determine the spacing of the outlets in the riser.
2. Select the column with the correct spacing (shown below each column). If the spacing of the outlets in your system is not one of the numbers shown, yet all outlets are evenly spaced, use the column which has the closest larger spacing to that of your system (e.g., for a spacing of 22', use 25').
3. Starting from the lowest outlet in the column you select, count up the number of outlets in the riser. The figure outside the highest box shows the required input level in dbmv. The figures inside the boxes show the required isolation of the tapoffs.

EXAMPLE: 12 outlets spaced 10' apart

From the first column, we read:

(1) required input to riser is 25.4 dbmv
(2) last 3 outlets in system need 12 db isolation (e.g., V-1P12 or V-1S12-X)
(3) next 6 outlets require 17 db isolation
(4) remaining outlets require 23 db isolation

expanded band capability. There is still a great deal of information needed before a real decision can and should be made, and we would like to introduce some of our thoughts into the discussions that are going on today.

EXPANDED BAND CATV CAPABILITIES

By

Dr. Leon Riebman and Mr. Walter Wydro

Of all the conventions that AEL participates in throughout the year, certainly the NCTA CONVENTION is by far the most dynamic and exciting. CATV is still in its infancy. New ideas for applications and a rapidly changing technology are the order of the day. The buildup for the Convention starts many months ahead with whispered rumors as to magical, new equipment and new system approaches that are being prepared for the Convention by all CATV manufacturers. The pressure of these rumors cause the engineering departments of all the major manufacturers of CATV equipment to put in many extra nervous hours in order to bring to the show advanced equipments ahead of schedule. Of all the fields of endeavor that AEL's 250 professional scientists and engineers are engaged in, certainly CATV is the most exciting and rapidly moving, technologically speaking.

CATV is our Number One commercial effort today! It is presenting a tremendous challenge to every technical discipline within our organization.

The CATV Industry today is in the painful throes of changing from an art to more of a science. When a field of endeavor is an art, decisions are based on emotions and judgments. In a true science, decisions are based on experiments and physical laws.

CATV will always be a mixture of art and science. The art will be the visualizing of future possibilities for applications of this new means of signal transportation. At the present time, the applications appear to be unlimited and the requirements on the system should be primarily the users' responsibility. The system owner should provide the specifications, in qualitative terms, for the requirements and the purpose of the system that he wants to build. Once the decision is made as to the ultimate purpose of the system, it becomes possible for systems designers and manufacturers to scientifically optimize design and cost for the most effective system based on existing state-of-the-art equipment.

The topic of our paper today is, "Expanded Band CATV Capabilities."

In the beginning, the first systems were only one or two channels. Then, low channels only came into being followed by a combination of low and sub-channel systems. Many of these original systems are still in existence.

More recently, interest developed in all-band or twelve channel systems. As a result of this requirement, broadband tube amplifiers were developed and the modern CATV industry took shape and began to grow.

Incidentally, during the first fifteen years of the CATV Industry much was done by intuition or cut and try. It was mainly art -- very little science. During 1964, 1965, and 1966, many very capable engineers working independently and building on the work of others worked out the ingredients of a theory for a fully integrated CATV System. This was the first time that various design parameters could be related and optimized for a particular system requirement. The theory is now being extended and perfected and will greatly accelerate the pace of developments and open new opportunities for new applications of CATV systems.

During January of 1966 AEL first discussed with a CATV user the possibility of building an Extended Bandwidth System (extended to 270 MHz). In October of 1966 a detailed proposal was written and equipment development started.

At this, the 1967 NCTA Show, AEL is offering a trunk extender amplifier and remote bridger amplifier with 270 MHz bandwidth -- a minimum of twenty channel system capacity.

In some geographical areas such as the corridor between Boston, New York, Washington, and Philadelphia or the corridor between San Francisco and Los Angeles, viewers can now receive twelve channels off the air. Thus, the need for more channels in CATV.

Let us review the various approaches to a system of more than twelve channels. Essentially five methods are being explored as feasible transportation systems.

1. The Sub-channel method -- this approach places twelve channels between the frequencies 5 MHz and 95 MHz.

2. The Mid-Band Method -- this method uses the spectrum between Channel 6 and 7. In particular, the frequency spectrum between 108 MHz and 174 MHz.

3. The Dual Coaxial Cable Method -- this method uses two coaxial cables each carrying twelve channels.

4. The Octave Band Method -- this method places 20 channels between 120 and 240 megacycles.