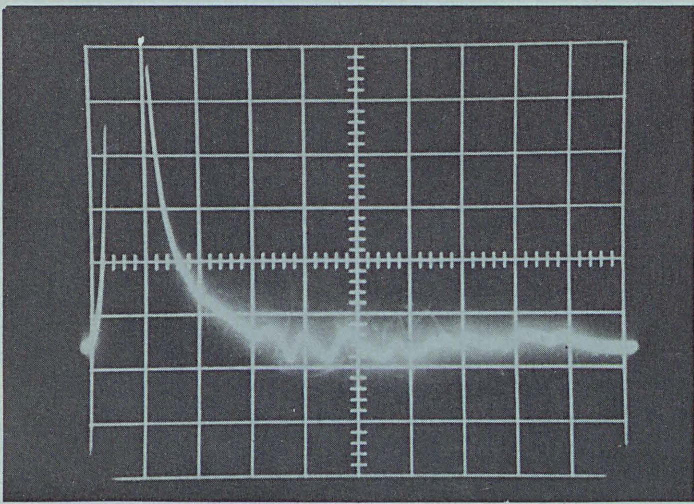
NEXT SLIDE PLEASE (#18)



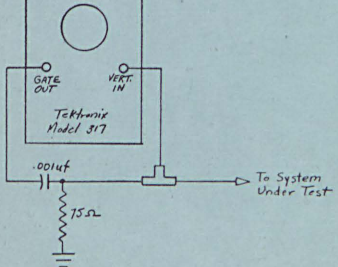
This is the same cable with the time base of the scope changed to .2 microseconds per division and the gain increased to .05 volts per division. At this setting of the scope, each division is worth about 80 feet of cable and you can see it is well riddled with reflections.

You have seen a few examples of what this type of testing can produce and with practice you can evaluate what is seen on the trace. We use this almost daily on our system, if not on the lines - in the shop for measuring partial reels of cable or displaying video wave forms from our microwave terminals.

For those interested in photography, the slides were taken using a 35 mm camera with a set of three portrait lenses attached. The lens opening of F4 and a shutter speed of 1/15 of a second and Ektachrome high speed type B film. We also take Polaroid pictures of wave forms using an old model 95 Polaroid camera and high speed film. Our total investment, including the "custom" mount for the scope is $100.00.

CHAIRMAN TAYLOR: Thank you very much. Are there any questions?

MR. SCHERPENSEEL: Somebody asked me to draw the diagram of the differentiating circuit, and I had better do that.



CHAIRMAN TAYLOR: Are there any other questi

Don't you have a tendency to do a lot of unnecess work of checking equipment when this doesn't check fr quency?

MR. SCHERPENSEEL: No, we are looking for fa This is a fault finder. We know and we check both end and you can see what is going on in between.

CHAIRMAN TAYLOR: Are there any other questi

This is not a question, but we have a lot of system that cannot afford a TDR or something similar, and th use the same technique on a television set for ghosting conditions. What they do is look at the output of the amplifier with a "T" monitor and by taking a ratio between the ghost and the width of the screen they can determine the location.

CHAIRMAN TAYLOR: Thank you very much. Do have any other questions or contributions?

From your title it seems to me it is "A Low Cost TDR," but when I look at the picture you have a fairly high priced scope. I wonder where the saving is?

MR. SCHERPENSEEL: It is relative. The TDR is around $3,000. It is all relative.

CHAIRMAN TAYLOR: Are there any other questio If not, we will take a short break for a moment.

(A short recess was taken.)

CHAIRMAN TAYLOR: It is always a pleasure at these functions to have guests from our Sister Country Canada. Our next speaker, I. Switzer, was born and educated in Calgary, Alberta. He received his B.Sc. degree in physics from the University of Alberta in 1949 and spent three additional years in post graduate study in physics.

His professional experience includes a number of years in electronic instrumentation and mathematical problems in petroleum geophysics, several years in applications analysis and programming in the electronic computer field, and association with the CATV field since 1954.

Mr. Switzer was a charter member of the Board of Directors of the Computing and Data Processing Society of Canada. He has been a director of National Community Television Association of Canada for a number of years. He is a member of I.E.E.E., S.M.P.T.E., and the British Society of Relay Engineers.

Mr. Switzer is presently chief engineer for Maclean Hunter Cable TV, Ltd. Maclean Hunter is a large Canadian publishing company diversifying into the cable TV field. Mr. Switzer. (Applause)

SUMMATION SWEEPING CATV SYSTEMS

By

I. Switzer,
Maclean Hunter Cable TV Limited
Toronto, Ontario, Canada

Performance standards for CATV systems are constantly being raised while the growing size of systems makes it constantly more difficult to achieve these standards. The setting of system operating levels and overall frequency response is one of the most important adjustments in the set up of new systems and the maintenance of established systems, and is usually very difficult to achieve to the desired standards of accuracy. This paper presents a practical technique for setting system operating levels and frequency response in an accurate and reasonably simple way.

System operating levels are usually checked and adjusted by measuring levels of individual channels with a field strength meter (FSM). Frequency response is conventionally observed by using swept frequency techniques. Combining swept frequency and level measurement techniques and applying them to a whole CATV system presents some special problems.

The first approach to the problem is to feed a sweep generator into the system "head end" and then observe and adjust the frequency response at each amplifier station down the line. Several problems arise:

1. adjustment of amplifier gain and level
2. synchronization of 'scope sweep
3. effect of sweep signal on amplifier AGC.

Most CATV sweep generators use the AC power line as a sweep drive. Sync and phase adjustment of remote displays is easily accomplished by locking the 'scope display to the power line. Many of the popular, low cost 'scopes used for CATV sweep displays have built in provision for horizontal drive from the power line. In cable powered, transistorized amplifier systems the detector and scope system are usually powered from some kind of generator system carried in a test van and the usual internal power line sync and phasing provisions of the 'scope cannot be used. In such cases we tap the AC power from the amplifier being adjusted and use it to provide a synch and phasing signal to the 'scope's horizontal deflection system. The circuitry details depend on the 'scope being used but can generally be worked out in a way that will provide the necessary horizontal deflection signal for the scope without loading the system's cable power. This permits good synchronization of the sweep generator at the head end with the detector and scope system at the system amplifier station under adjustment.

Some sweep generators can be operated in either a free running or line triggered linear sweep mode. In such cases 'scopes with a reasonably versatile sweep triggering system can be synchronized to the head end sweep.

A comparison technique is used to adjust the amplifier gain and operating level at the same time that "flatness" of response is observed. The sweep signal being observed is put onto one side of a high speed co-axial switch while a reference CW signal is put onto the other side of the switch. When the switch is operated at its normal 15 or 30 Hz speed, the reference signal and sweep are both displayed. The sweep appears in its normal form, while the reference appears as the top of a 15 or 30 Hz square wave arising from the chopping action of the co-axial switch. The two signals can be easily compared and the sweep coming out of the amplifier can be adjusted to the desired level and flatness using the amplifiers gain and tilt controls. Thus tilt and level are observed and adjusted at the same time.

Any frequency can be used for the reference CW source as long as it is within the flat frequency response of the detector used. We have used low cost kit type RF generators, monitoring their output level with a good FSM. In other cases we have used lab type RF signal generators. The reference used will depend on availability of equipment and the accuracy desired. The reference source permits "average" level to be measured as well as depths of "peaks" and "valleys" in system response.

It is convenient, when using this technique, to work on the basis of "flat output" at an amplifier. Each amplifier is adjusted to exactly compensate for the losses and tilt of the immediately preceeding cable section. This technique will result in an overall system response that is flat. Final system operation may be on a full tilt, partial tilt, or block tilt basis, but this adjustment is made by adjusting channel levels at the head end. The transmission system itself must be flat irrespective of the tilt system used in actual operation.

Some systems will have a very long cable stretch between head end and the first amplifier section to take advantage of the fairly high output capability of most head end signal processing units. In this case we have found it necessary to carefully adjust an accessory equalizer to compensate for the extra cable length, so that the combination of first cable section and first amplifier will be flat.

One of the aims of this technique was to develop a technique that would make all necessary adjustments under actual system operating conditions. This requires activation of the system's AGC during adjustment. We have accomplished this by mixing the required pilot carrier with the sweep signal at the head end. A trap is used to notch the sweep at AGC pilot frequency to prevent undesired beat effects and to prevent the sweep signal from activating the amplifier AGC's.

The response of amplifier AGC to swept excitation should be carefully studied. We first found it a serious problem when we undertook the set up of a 43 amplifier string of Jerrold Starline amplifiers. We had installed a narrow "high Q" trap as an AGC notch to trap 73.5 MHz out of the head end sweep signal. As we moved down the line adjusting amplifiers we found a peculiar hump building up around 73.5 MHz. It took a while to determine that the amplifier AGC system had fairly broad frequency response and was responding to sweep frequency signals around 73.5 MHz even though 73.5 MHz itself had effectively been trapped out of the sweep. We made a careful study of the response of the AGC system in this particular series of amplifiers and found that we had to broaden our trap considerably in order to completely suppress response of the amplifier AGC to sweep signals around 73.5 MHz. In this particular case we ended up with a notch about 4 MHz wide around 73.5 MHz. This trap was built by adapting a channel reject filter. Be sure that traps used for this purpose have flat response outside the reject band.

Some ingenuity is required to devise systems for bringing the amplifier being adjusted down into the service van. In the case of the Jerrold Starline chain previously mentioned we used a carefully selected medium sized jumper of minimum length. The amplifier plug in module was brought down to the van. In this particular equipment series the cable power continues through the amplifier housing even when the amplifier module is removed. A light weight jumper was used to bridge the cable power to power the amplifier in the test van and to provide the synchronization signals for the 'scope and high speed co-axial switch. The jumper was selected for quality and average impedance match to the main line cables in use by checking with bridge and TDR. We are working toward a very light weight portable instrument system that will be light enough to be carried up to the amplifier and which will permit test and adjustment of the amplifier in place in its messenger mounted housing. This will require development of a very flat, high impedance, active probe that will permit accurate monitoring through the test points provided.

Some problems were experienced with the comparatively low output levels at which amplifiers in large systems operate. A typical level is about +32 dbmv. This level will drive most detector and 'scope systems in a satisfactory way, if all of it is available, i.e., if the full amplifier output is available to drive the detector. If output must be monitored through a -20 or -30 db test point some problems arise. These can be overcome by using good quality calibrated booster amplifiers, very sensitive detector and scope systems, or by use of a good quality high impendance "active" test probe to bridge the amplifier output.

In the 43 amplifier chain previously cited it was possible to achieve correct set up of each amplifier's operating level to the accuracy of the reference generator used, in this case a Measurements model 80 signal generator, and to achieve an overall system response at the 43rd amplifier of ± 1 1/2 db, or 3 db total peak to valley. Amplifiers had been carefully prealigned on the bench through actual lengths of the cable type used on the line and then installed at the station for which they were intended. Jumpers were carefully chosen to match average main line cable used in order to minimize jumper effects. Amplifier gain and tilt adjustments were then made to get the desired response and operating level. In these particular amplifiers it was found necessary to try different equalizers, to make fine adjustments to equalizer trimmers, and to adjust the input and output match trimmers to get optimum flat response. Internal response trimmers were occasionally adjusted. Remember that a consistent 1/4 db misalignment in each amplifier adds up to almost 11 db in a 43 amplifier chain. If any drastic adjustments are necessary we check the response at the input to see whether there is any problem in the cable itself. In this case of setting up a new system, the cables had previously been very carefully checked with bridge and TDR before acceptance from the cable installation contractor, and no cable problems were experienced. We did have some troubles with badly matched fixtures on the line. These were immediately apparent as ripples in the response of the system caused by standing waves set up by the mismatches. It is interesting to note that the "fine structure" in a system's overall frequency response is related to mismatches and ghosts in the system. Detailed studies in the field require slow sweep speeds and 'scope systems capable of displaying such slow sweeps.

CHAIRMAN TAYLOR: Thank you very much. (Applause) Do we have any questions on this subject of "Summation Sweeping CATV Systems" as given by Mr. Switzer?

You mentioned the problem of not enough level on the tapped outputs. Have you noticed any problem of non-linear on the tapped output in comparision to the input?

MR. SWITZER: In the case of the Starlines, without giving them a very intentional sales boost, they use the same test probe that you carry along with you from one amplifier to another, so you are working consistently with the same one. These are the only amplifiers we have done a great deal of work on with the summation sweeping system. We make a practice now of actually checking the test points on the amplifiers, to callibrate them and make sure that they do agree. We run a calibration on them for those types of amplifiers.

I was wondering what kind of generator is used at the head-end equipment?

MR. SWITZER: We have used several.

How flat is the generator used?

MR. SWITZER: The final overall flatness of the sweep is dependent on the flatness of the notch filter that we use. We generally check it in place at the head-end, and if it becomes really critical, you can subtract it out by marking it on your screen or taking a picture of it so that you know if was flat to this degree at the head-end. We are not looking for an absolute straight line.

CHAIRMAN TAYLOR: Any other questions?

I know Mr. Switzer, and I was with him when we originally set the system up.

MR. SWITZER: I will commend Ted in having been the chief technician on the system when we first pioneered this system three years ago. Ted and I went out to set up the first all-channel system we had ever dealt with, and we were following the manual with the manufacturer's instructions which said, "Tune to Channel 2 and read the level. Then tune to Channel 13 and read the level." We did that with just one station, as we felt there should be a better way.

As you know, we had quite a problem with the higher frequencies at the time. I have not followed up on this technique because it was very unsatisfactory. I have about five or six amplifiers, but I notice you were talking about the Starline with the amplifiers, or where the cable goes right into the amplifier. Do you consider this still a problem with the cable going through connectors and jumpers, and so forth, and what effect does this have on the long system?

MR. SWITZER: The problem we had back in those years, Ted, on that particular system was that the system had the old UHF connector right through, and this gave us a very serious standing wave problem, particularly at higher frequencies with jumper systems, but with careful attention to the impedence of jumpers, by having access to good bridges and TDR systems now, we can keep this standing wave problem under control. If we backed it up on the older system with newer connectors and a better standing wave situation in general in your older system, you would find it works out nicely.

CHAIRMAN TAYLOR: Any other questions?

At the end of it do you see any amount of noise?

MR. SWITZER: This depends on the level. The hum might be cleaned up by a better balanced detector, but we have preferred to hold the RF levels in the detector up to the plus 30 level, and there the grass is not a problem. We don't use it to try to evaluate noise at that point. This is a completely separate measure.

CHAIRMAN TAYLOR: Any further questions? If not, thank you very much. (Applause)

For our next presentation a name was omitted from the program. This next paper will be presented by two men, both of whom are systems operating technicians, and I need to apologize profusely to Bob Brown for the omission of his name as a co-author of this paper.

Robert J. Brown is the engineering manager of Tele-Vue Systems at the home office in Seattle, Washington. He was technical vice president of the Pacific Northwest Cable Television Association. He spent twelve years in Community Antenna Television from installer to his present position as engineering manager. He has been with the same employer through all of this time in a long and noteworthy career in CATV.

Joining with Mr. Brown will be Mr. Jerry Laufer, Vice President, Engineering of the Telecable, Inc., of Seattle, Washington. He has also been technical vice president of Pacific Northwest Cable Television Association, and he is at this time.

He has eight years with the U.S. Air Force as an electronics technician, seven years in Community Antenna Television at Eugene, Oregon, Great Falls, Montana, Laguna Beach, California and as a sales engineer for Jerrold Electronics.

He joined Telecable in 1956 as vice president for engineering. Bob will speak first; and it is with great pleasure I present Bob Brown and Jerry Laufer who are presenting a very interesting presentation on "Practical Design Based on Complete Equipment Evaluation."