SPECIALIZED TEST EQUIPMENT FOR CATV DISTRIBUTION MEASUREMENTS

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INTRODUCTION

Historically, the test equipment used in setup and trouble-shooting of the CATV distribution system has evolved from the early days of little or no test equipment to today's practices of adapting laboratory type equipment for field use plus a continually growing use of low priced signal level meters. It is true that test equipment manufacturers have recently "discovered" CATV and produced a rash of 75 ohm units. Now it is possible to put together an impressive array of test equipment and study in detail a system amplitude, phase and delay transmission characteristics, providing one can keep the equipment operating long enough and can cope with a lot of other practical problems associated with getting around and tapping into a CATV distribution system.

Over a period of years the authors have been "witness to" or participated in field excursions where the Ritual of a "count down" was observed to make sure that all of a multitude of pieces were safely stored aboard a vehicle before departing. More often than not it has been normal for a critical piece of gear to be left behind or to find that transportation vibration has killed some thing crucial to completion of the appointed task. The frustration of these experiences can be matched only by the problem of trying to interpret data taken on equipment with built-in errors, which mask the significance of that data.

These experiences have lead to belief that there is a crying need in the industry for a quality specialized test set capable of making basic field measurements with reliability and precision required by today's standard of performance. The authors contend that such a basic instrument makes much more economic sense than elaborate time domain reflectometry and spectrum analyzers which certainly have their place at today's level of sophistication.

In retrospect, it is somewhat surprising that the economics advantages of such test equipment have not been properly recognized. The true cost of errors and delays due to test equipment problems can be staggering. Hundreds of dollars per day in labor wasted, vehicle charges, customer aggravation - these items add up quickly to pay for a $2,000.00 item, which can save down time or prevent errors. Utility companies and the military have long recognized the need for "test sets" specifically designed to "set up" and adjust complicated systems in a rapid and foolproof manner. Perhaps the authors

draw an unfair comparison with manufacturing where it has become normal to review such expenditures for tooling in terms of labor saving dollars. Certainly if this were done, the demand for such test equipment would have been much stronger.

GENERAL

With this previous discussion as background, it can be stated that this paper will describe a test set designed and slated to be produced on a "limited edition" basis at C-COR for the express purpose of making the "nuts and bolts" measurement of signal level, noise, and distortion throughout a CATV system. The major economic motivation in our case is the potential improvement in efficiency in our own Systems Engineering Department.

In addition, certain specialized production test units constructed and used by C-COR will be briefly discussed. Some of these represent the forerunner of the circuitry used in the test set; others are shown because they illustrate the similarity between field test and production test or may have some value around a maintenance laboratory.

A review of some of these factory test units, designed and built at C-COR will follow in the succeeding paragraphs.

FACTORY TEST EQUIPMENT

Some of the problems associated with factory testing are very similar to those encountered in the field. For instance, one of the most critical is the frequent calibration of selective RF voltmeters and the radio and frequent measurement of things like noise figure at spot frequencies. To facilitate these operations, we have constructed two basic test units. The first shown in Slide I is a Level Calibrator, which is simply a stable multiple signal source that is periodically calibrated by the Quality Control Department. Test personnel plug their meters into the calibrated ports for frequent calibration at commonly used levels but are not able to tamper with the calibrated unit. This latter statement is a recurring theme in this kind of testing.

A related item is a Switchable Fixed Tuned Converter shown in Slide II. This unit, where used in conjunction with a noise figure meter, provides quick and foolproof measurement at a number of spot frequencies. Adequate filtering is provided to avoid spurious responses. Likewise, levels at spot frequencies can be quickly measured without turning or adding calibration factors. Finally, the converter provides an acceptable means of extending the frequency range of other equipment.

As a matter of interest, it is worthwhile to take a quick look at some other pieces of specialized test equipment. A Cross Modulation Test Set of modular construction (Slide III)

where an attempt has been made to design a self-contained work station, which is occupied for some 16 hours a day. The Hum Modulation Test Set and the Lightning Test Set shown in Slide IV and Slide V illustrate units built to fill a need not met on the commercial test equipment market.

One important point to be made at this stage is that many items similar to those shown can be constructed in an equipped CATV laboratory, if they have reasonably ingenious personnel and (1) learn to seek out "circuit modules" available commercially and (2) modify commercially available instruments.

CATV DISTRIBUTION TEST SET

As was previously mentioned, the test set evolved from circuitry which was initially designed for production test and from a prototype built for preliminary evaluation. This prototype is pictured in Slide VI. General characteristics of the revised unit now being designed are shown in Figure 1 with data on the feasible tests included in Figure 2.

Block diagrams of the internal components of basic test set and the transmitter unit are shown in Figures 3 and 4.

APPLICATION

For use by technical personnel in balancing, aligning, trouble-shooting, monitoring, evaluating performance before serious deterioration of distribution.

PHYSICAL

Self-contained, MIL quality with regard to ruggedness - suit-case format for airline travel.

ELECTRICAL

"Secondary standard" type stability with wide calibrated operating temperature range (-20, +120° F). Calibration where possible controlled by transmitter at antenna site.

Sensitivity sufficient to look at cascading effects. Internal modular construction, for repair and calibration check.

GENERAL CHARACTERISTICS CATV DISTRIBUTION TEST SET

FIGURE 1

SIGNAL LEVELS

Typical selective voltmeter usage except that no compensator knobs are needed. "Panoramic" operational mode to provide ready view of relative levels on six channels.

SIGNAL-TO-NOISE

An internal amplifier with 6 dB noise figure to make feasible measurements at low signal levels.

IM PRODUCT & SPURIOUS SIGNALS

Capable of measuring -60 dB under CATV conditions.

HUM MODULATION

At least -60 dB (.1%).

CROSS MODULATION

A relative measurement which can be related to -60 dB in a multiple channel system.

SOME POSSIBLE TESTS USING CATV DISTRIBUTION TEST SET

FIGURE 2

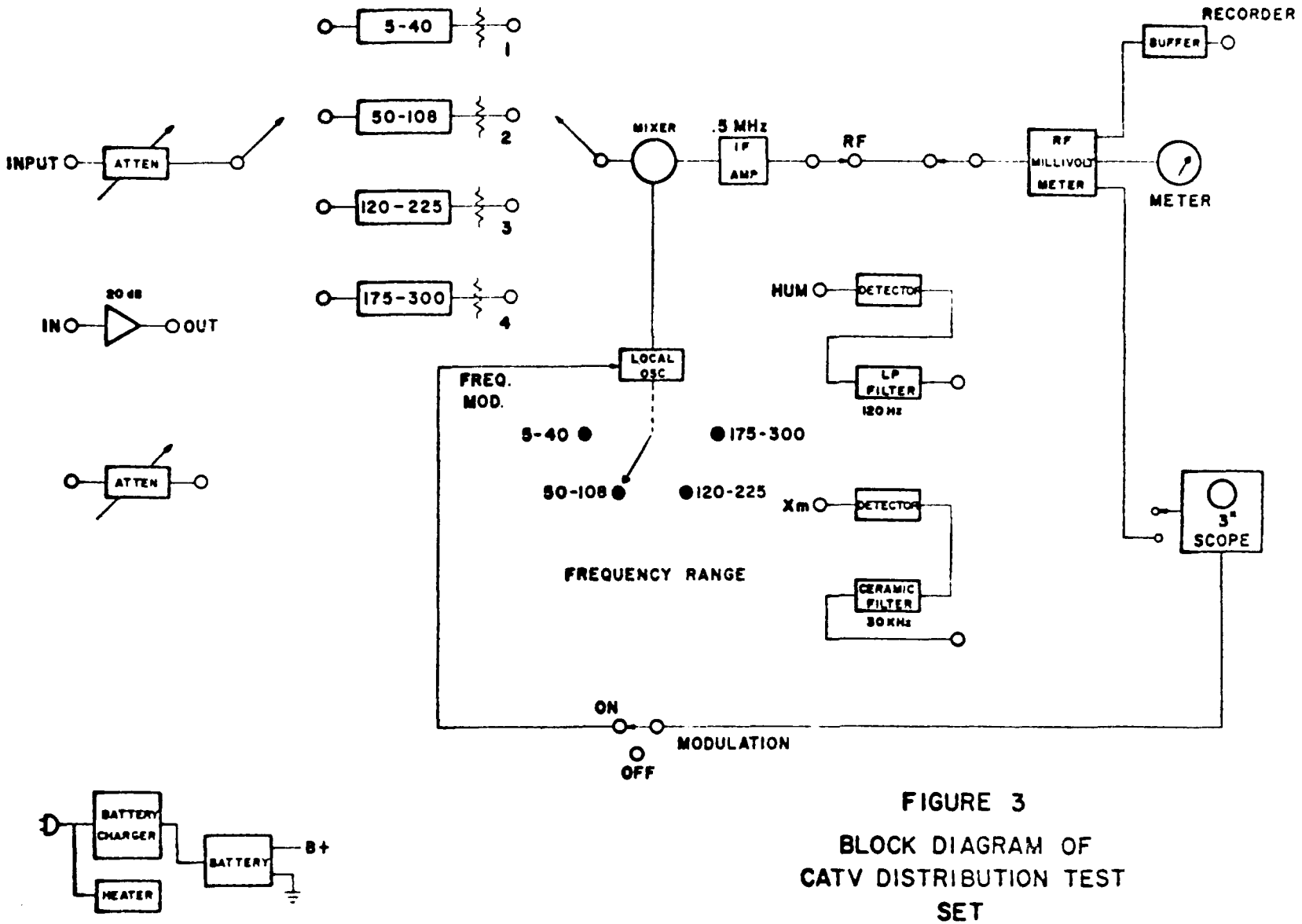

FIGURE 3

BLOCK DIAGRAM OF
CATV DISTRIBUTION TEST
SET

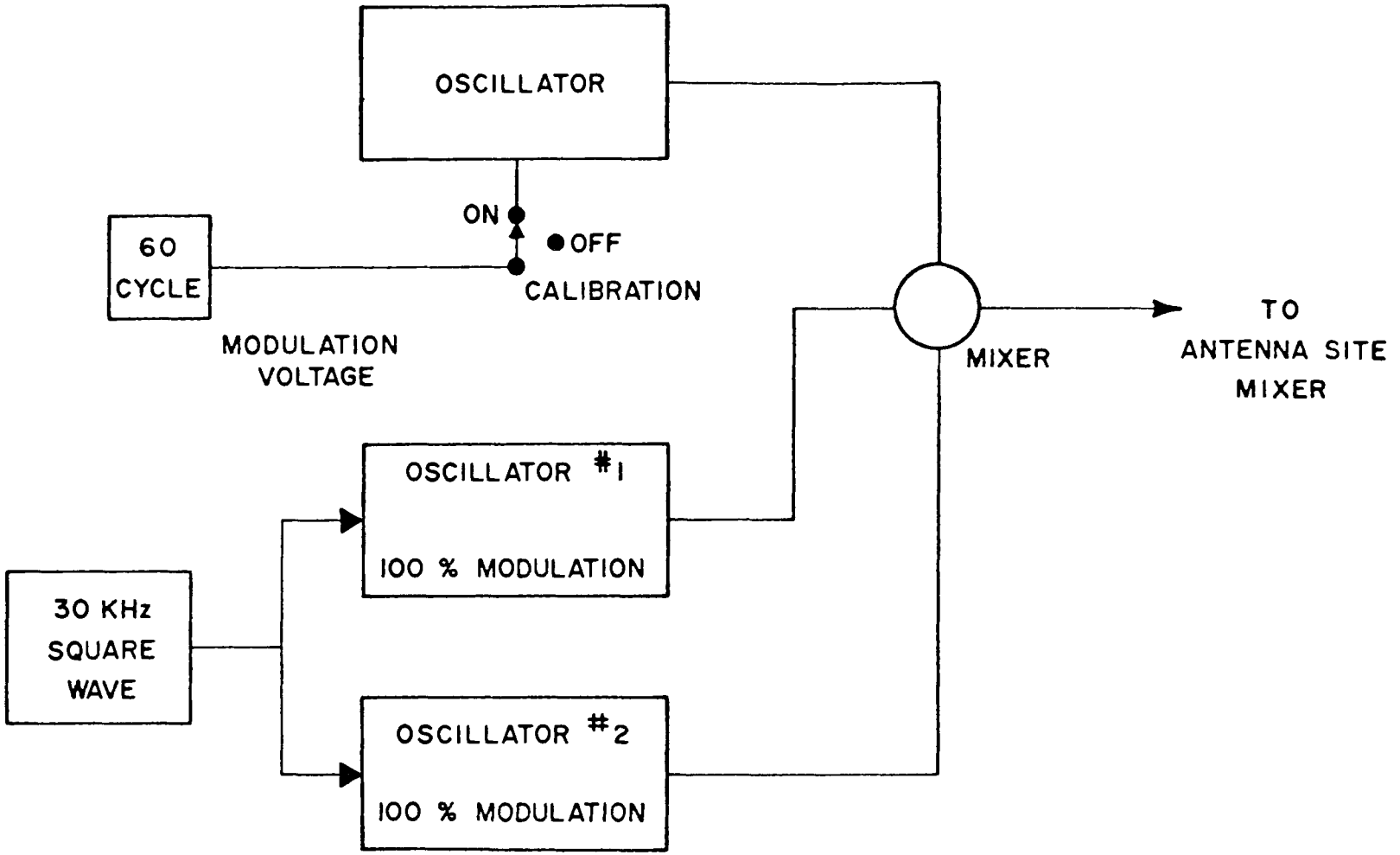

FIGURE 4

TRANSMITTER FOR CATV DISTRIBUTION TEST SET