FIELD STRENGTH MONITORS

A UNIQUE TEST INSTRUMENT FOR CATV

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INTRODUCTION

A Field Strength Monitor is a new and unique test instrument designed especially for the CATV industry. A Field Strength Monitor combines the functions of a field strength meter, a television monitor, and a video display in one portable instrument. The Field Strength Monitor can be used to measure the signal strength of any VHF or UHF TV signal while observing the picture and sound on the television monitor. This provides the capability to observe any interference in the video or audio TV signals while measuring the amplitude or strength of these signals. The video display provides an oscilloscope-type look at the vertical blanking and sync pulse. This gives an indication of any overloading or sync clipping in the distribution amplifiers. This versatile instrument can be used in the lab to calibrate front-end equipment; in the field to adjust line amplifiers; and in the home to demonstrate the quality of CATV signals.

MODES OF OPERATION

The Field Strength Monitor, FSM, has three modes of operation. A function selector switch on the front panel is used to select the desired operating mode. When the function selector is in the TV mode, the FSM operates as a normal TV. This mode can be used to determine or demonstrate the picture and sound of any VHF or UHF TV channel. The metering circuits are not connected in this mode. When the function selector is in the FSM mode, the FSM operates as both a field strength meter and a TV. The video and audio carrier signals of any VHF or UHF TV channel can be measured while observing the picture and sound. When the function selector is in the Video Display mode, the FSM displays the vertical blanking pulse and the vertical sync pulse on the CRT (picture tube). A block diagram of the FSM system in the FSM mode is given in Figure 1. A similar block diagram of the FSM system in the Video Display mode is given in Figure 2.

SYSTEM CHARACTERISTICS

The FSM can be used to measure the signal strength of any VHF or UHF TV signal from 30 microvolts to 3 volts. A 90 db attenuator is provided in the FSM. The FSM will provide a usable picture on the TV monitor with an input signal of 100 microvolts or more. Any VHF channel from 2 through 13 can be selected on a switch in the VHF tuner. The UHF tuner provides continuous tuning from channel 14 through channel 83. The input impedance to the FSM is 75 ohms. The FSM has a special compensation amplifier circuit to insure that the gain is

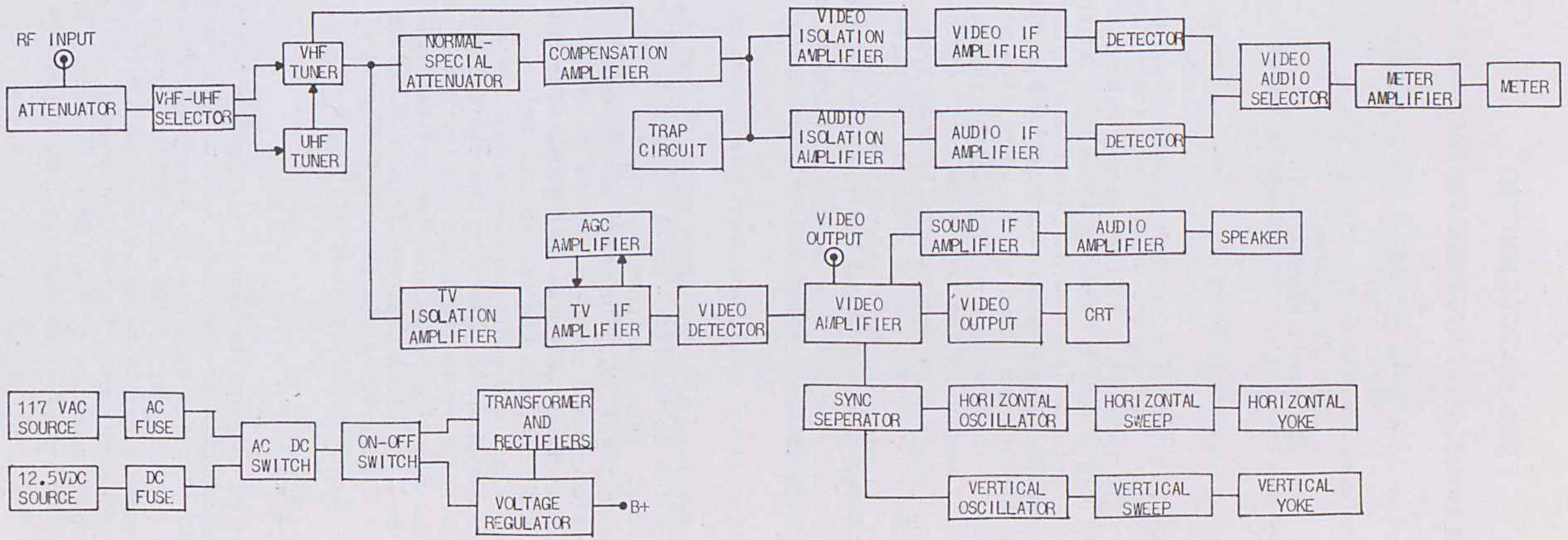

FIGURE 1
FIELD STRENGTH METER MODE
FIELD STRENGTH MONITOR

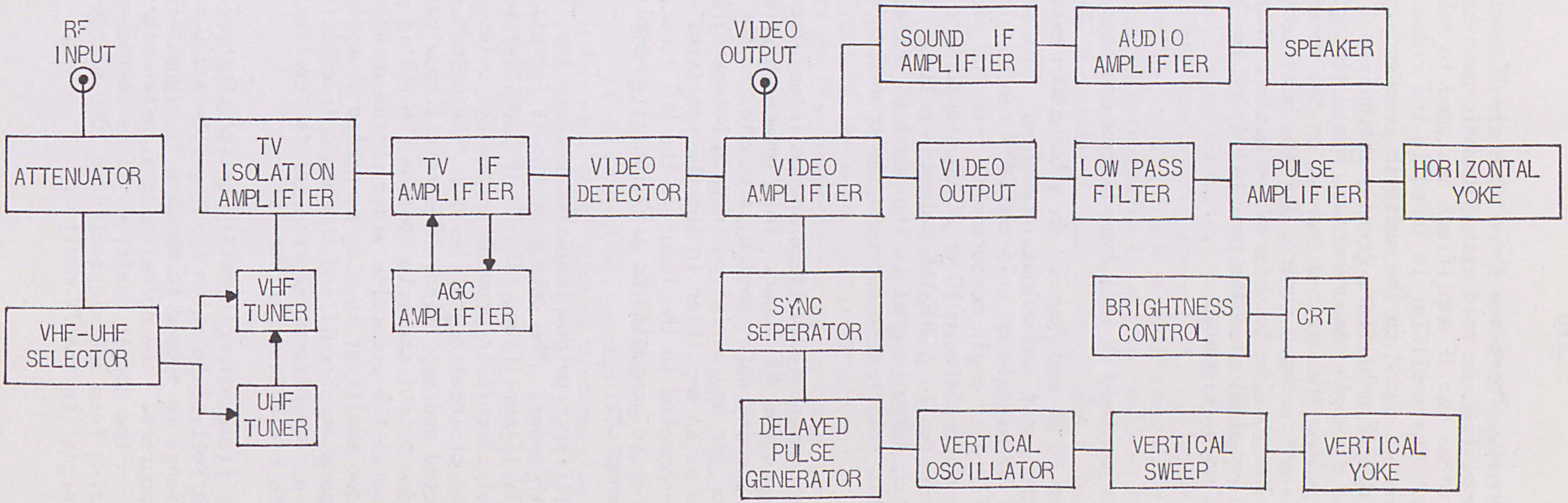

FIGURE 2
VIDEO DISPLAY MODE
FIELD STRENGTH MONITOR

the same for each channel. There are three seperate IF amplifiers in the FSM. One IF amplifier is used with automatic-gain-control for the TV monitor. The other two IF amplifiers are used to make field strength measurements. One amplifier is tuned to the video IF frequency and the other amplifier is tuned to the audio IF frequency. The use of seperate video and audio IF amplifiers greatly simplifies the tuning required to make field strength measurements. Field strength measurements are made by selecting the desired channel on the tuner and adjusting the tuner fine frequency control for the best picture and the peak meter reading. The ability to observe the picture while adjusting for a peak meter reading eliminates the possibility of tuning to an adjacent channel or a noise signal.

SYSTEM DESCRIPTION

The RF input connector on the FSM is a type F coax connector.

The attenuator has one 10 db and four 20 db attenuation circuits. The attenuator has a 75 ohm input and output impedance. This permits direct measurement of TV signals on a 75 ohm CATV cable. The attenuator can be used to make field strength measurements from 300 microvolts full-scale to 3 volts full-scale in 10 or 20 db steps. The output of the attenuator is connected to a VHF-UHF selector switch. This switch connects the attenuator output signal to the input of either the VHF or the UHF tuner. This switch also connects the unused tuner input to ground.

A special temperature compensated voltage source is used to provide constant bias voltage to the VHF tuner. This insures a constant gain in the VHF tuner. A special wafer switch is mounted on the VHF tuner to permit compensation for any variation in gain between VHF channels. The VHF tuner is used as an amplifier in the UHF position. The output of the UHF tuner is connected to the input of the VHF tuner. The output of the VHF tuner is connected to a TV isolation amplifier and a normal-special attenuator.

The TV isolation amplifier provides isolation between the TV monitor and the field strength meter. The output of the TV isolation amplifier is connected to the TV IF amplifier. The TV IF amplifier has an automatic-gain-control circuit to provide a constant output signal level for a wide range of input signal levels. The output of the TV IF amplifier is detected and amplified. The resulting video signal is connected to a video output connector on the FSM. This provides the capability to observe the composite video signal on an oscilloscope. The output of the video amplifier is also connected to a video output amplifier, a sync seperator circuit and the audio IF amplifier. These circuits function as a conventional TV receiver to provide the TV monitor portion of the Field Strength Monitor.

The amplifiers in the field strength meter portion of the FSM were designed to provide a full-scale meter reading with a 300 microvolt input signal. This range is needed to measure TV signals from antennas and other low-level sources. The normal-special attenuator provides 10 db of attenuation in the normal position. This increases the normal full-scale meter reading from 300 microvolts to 1000 microvolts without attenuating the signal to the TV monitor.

The compensation amplifier provides a seperate gain control for each channel. This circuit is used to compensate each VHF channel for any variation in gain.

The output of the compensation amplifier is connected to a video isolation amplifier, an audio isolation amplifier and a trap circuit. The isolation amplifiers are used to prevent any interaction between the video IF amplifier and the audio IF amplifier. The trap circuit is used to attenuate the video signal of the adjacent channel to prevent any interference with the audio signal being measured. The video and audio IF amplifiers have three insulated-gate field-effect transistor (MOST) amplifier circuits. Parallel resonant transformer coupling is used between stages. The selectivity of the IF amplifier is controlled by varying the Q of each stage. The AC load resistance of each stage is selected to obtain the desired Q. The audio IF amplifier is more selective than the video IF amplifier because the audio IF signal has a relatively narrow bandwidth. The audio carrier signal level on a CATV system is normally set 12 to 18 db below the video carrier signal level to reduce interference. This is another reason the audio IF amplifier is more selective than the video IF amplifier.

Each IF amplifier has a diode detector circuit to convert the IF signals to a DC signal. The DC outputs of the video and audio IF amplifiers are connected to a video-audio selector switch. This selector switch is used to connect either the video or audio DC signal to the input of the meter amplifier circuit. A matched pair of junction field-effect transistors are used in the meter amplifier to insure temperature stability. The output of the meter amplifier is connected directly to the meter. The meter scale has two microvolt ranges (0 to 300 and 0 to 1000 microvolts) and one db range (-20 to 0 db). The full-scale meter reading in db is always equal to the total attenuation selected in the attenuator.

When the FSM is used in the Video Display mode, the detected composite video signal is disconnected from the CRT by the function selector switch and the horizontal yoke is disconnected from the horizontal sweep circuit. The composite video signal is filtered with a low-pass filter to remove the video information. The vertical blanking and sync pulses are not filtered out of the video signal by the low-pass filter. The output of the low-pass filter is connected to a pulse amplifier circuit. The pulse amplifier circuit generates the power necessary to drive the horizontal yoke with the vertical blanking and sync pulses. The function selector switch also connects a special delayed pulse generator circuit between the sync seperator circuit and the vertical oscillator when the FSM is used in the Video Display mode. The delayed pulse generator delays the vertical sync pulse approximately 8 milliseconds. This places the vertical blanking and sync pulses in the center of the CRT.

The overall accuracy of the FSM in VHF Normal is $\pm$ 1.5 db at 25°C. VHF Special and UHF accuracy is $\pm$ 3.0 db. The FSM can be operated from either 115 volts AC or 12.5 volts DC.

CONCLUSIONS

A Field Strength Monitor is a unique CATV test instrument that can be used to accurately measure the field strength of any VHF or UHF TV signal while observing the picture and sound. CATV engineers and technicians can use the FSM to detect any noise or interference in video or audio CATV signals. The FSM can also be used to observe the vertical blanking pulse and vertical sync pulse. Antenna radiation patterns can be easily measured and observed with this instrument. Three seperate IF amplifiers are used to insure optimum selectivity and sensitivity. Selected field-effect transistors are used to assure stability and accuracy. The ease with which TV signals can be measured with the FSM will significantly reduce the time required to evaluate or service CATV equipment. The Field Strength Monitor provides an accurate instrument to measure and demonstrate the quality of a cable system.