ROBERT C. EHLE

A Homebrew Multi-Media Show

Using a couple of your surplus amplifiers, an oscilloscope, and an old t.v. set, you can combine sound with dancing visual patterns.

WHAT MUST INTRIGUE many experimenters is the notion of how they might utilize the technology they already have available and produce an interesting and sophisticated result with relatively little effort. I was thinking one day of the variety of sophisticated electronic devices I have on hand and how I might interconnect them to produce various results. I have, for example, five television sets, five radios of various bands and types, ten or more amplifiers of various sorts, and four tape recorders. I might add that I do electronic music experimentation and like to connect such things as tape delays through several tape recorders, feedback loops through radio receivers using phone oscillators, and so forth.

My rumination turned to using some of those television receivers for an interesting experiment. Basically, the proposed technique was to use several of those amplifiers I mentioned to control the beam of a large screen television so that sounds would produce the pictures and one could watch his recordings in operation, or whatever else appealed to him.

As there are many ways that this project might be carried out, I will describe the equipment I used and how I did it and others can adapt this to whatever they have on hand. I have a 23-inch General Electric black/white television set with a weak picture tube. The picture is too dim for viewing comfortably. The set has a power transformer power supply. I also have a stereo radio/phonograph with transistor output, balance control, tone control and volume control. The phono input takes ceramic cartridges.

I used the stereo phonograph amplifiers to drive the deflection yoke of the 23-inch television set. Basically, this simply involved disconnecting the speakers from the amplifier, the deflection yoke from its outputs, and connecting the amplifier to the yoke. I used the left channel for vertical deflection and the right amplifier channel for horizontal deflection. Then I connected the stereo amplifier in parallel with the pre-amp output of my sound system.

VOLUME CONTROL

In operation, the volume control on the stereo amplifier controls the size of the display, the balance control determines the percentage of vertical to horizontal deflection, and the tone control handles detail in the display. A signal appearing in the right channel only produces a horizontal line, while one in the left channel produces a vertical line. Separate signals in the two channels produce lissajous patterns while stereo signals of varying phase create rotating patterns of various sorts. These are generally the most interesting of all and make very clear the difference between true stereo and synthetic stereo, which has different material on each channel.

The impedance of a high-fidelity amplifier intended to drive dynamic loudspeakers is close to that needed to drive deflection yokes, which are, after all, simply coils of wire similar to voice coils. Five to ten watts of amplifier power seems to be sufficient for even a 23-inch set; less would be required for smaller sets having less deflection. Although my television set was weak and did not produce sufficient brightness for pictures, I discovered that this was not a serious drawback in the application to sound displays because the beam does not move as fast nor cover so great an area as it does in television applications. The result is apparently greater brightness and contrast.

Z MODULATION

In a normal television picture, the detail is produced against the raster by intensity-modulating the beam of the picture tube. This detail is normally inverted so that no

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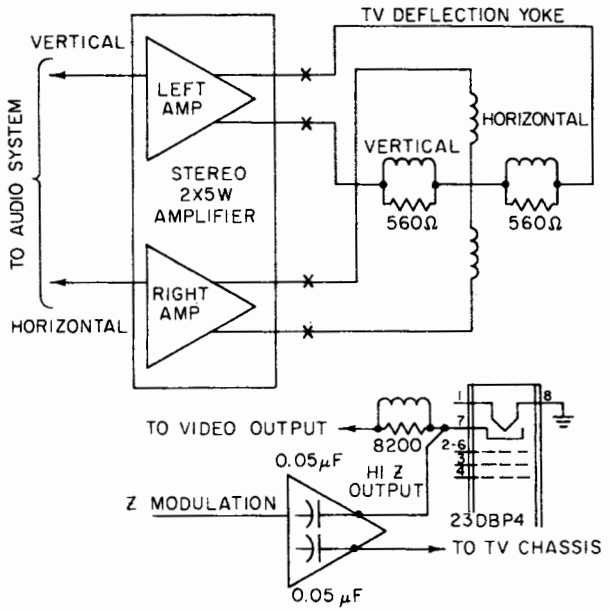


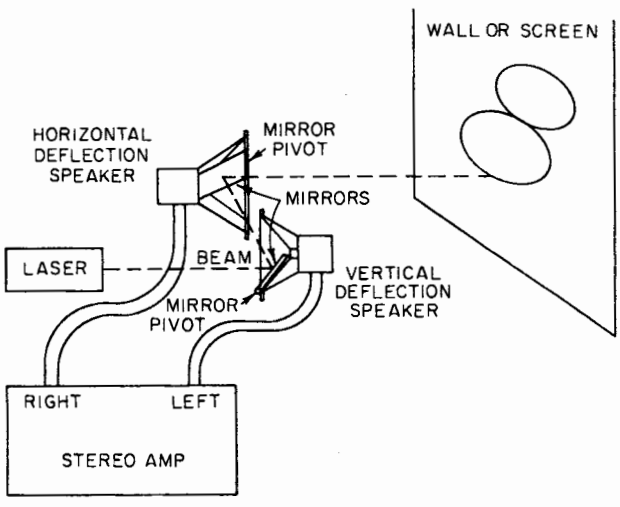
Figure 1. Circuit to modify a television set to display lissajous patterns from stereo sound.

signal produces a light screen and the presence of dark elements in the signal drive the tube toward cut-off. This intensity modulation is called *Z axis modulation* when applied to oscilloscopes and it can be incorporated into the setup described above.

In my own situation, I employed an old Admiral vacuum-tube radio amplifier for Z axis modulation. The advantage of using a vacuum-tube amplifier is that high impedance and a high voltage swing are required and can be easily obtained from such a unit. The output from the amplifier is taken from the primary side of the output transformer through two 0.05 microfarad capacitors to the cathode and chassis of the television set (which should have a transformer in the power supply). If no transformer was included in the set you choose to use, you should add an isolation transformer to eliminate shock hazard.

In using Z-axis modulation, full brightness will be obtained from a display on the left and right channels when the Z-mod. channel amplitude is zero. As a signal is inserted on the Z-mod. channel it will cause blanking to occur in areas of greatest signal amplitude. The effect of this on a display is to turn normal lissajous patterns into a series of dotted lines. It should be noted that even if you do not connect a Z-modulation circuit, the normal video output circuits may be used and a television signal received from a station may be used to Z-modulate the patterns in a random manner.

Figure 2. Diagram of a laser modulation system, useful for projecting oscilloscopic displays.



MORE EXPENSIVE ADDITIONS

In addition to the circuit described, other variations may be employed. These include using a color t.v. set, use of dot, bar and test pattern generators, use of color dot and bar pattern generators with color sets, employment of projection television systems, causing a pre-recorded video tape recorder to play back special patterns, and use of laser deflection systems. However, most of these ideas require expensive equipment, not generally available in surplus to the experimenter Still, it is worth considering a few points in connection with a few of the above additions.

USE OF A COLOR TV

Not too many of us have a surplus color t.v. set around just for experimenting but in case you do, there are a few additional things you can add to the system. In the first place, a color set has only one set of deflection coils, so you can only drive one signal to the vertical and one to the horizontal, just as in the case of the monochrome set. The color set has three guns, however, and each one of these may be individually intensity-modulated.

The three guns are deflected together by the coils and focused on a triangle of dots in the three colors on the phosphor screen so, assuming that convergence, purity, etc. have been correctly set up before the sweep circuits were modified, each gun will tend to keep its place in the triangle with the other two. Note, though, that the amount of deflection is a variable, depending on the input signals, so there is no way that each gun can project only on its own color of phosphor. Thus, there is no way to predict which color each gun will energize.

Therefore, the color-patterns will be random. In intensity-modulating each of the three color guns, a separate amplifier is required, just as a single amplifier is used for a monochrome set.

USE OF COLOR AND MONOCHROME PATTERN GENERATORS

These generators have circuitry that generates signals which coordinate with the vertical and horizontal oscillators in a television system. Therefore, once the internal oscillators have been disconnected, there is no way to project the intended patterns. The effect will be random intensity modulation.

PROJECTION SYSTEM

A few expensive projection systems have been built. If one is lucky enough to have a theater with a projection video system for television, this may be used. Most color projection systems are not particularly intense. The most successful projection system for oscilloscopic display is a laser type, using two deflection mirrors attached to loudspeakers, driven from audio sources and a low power laser. Color systems have been built using several different colors of laser beams. Morton Subotnick, the electronic music composer and performer, uses such a laser projection system, along with movies, lights, synthesizers and prerecorded tapes in his multi-media presentations. The effect is quite spectacular.

SOUND DISPLAY UNIT

To get back to practicalities, I want to describe ways I've used my display system and the effects I've achieved. First, let me point out that I do electronic music demon-

strations in a rather small room and have often used oscilloscopes so that the audience can watch the waveforms of the sounds as I generate them with a synthesizer. The problem is the typical size of an oscilloscope screen (3-5 inches), but my 23-inch television set provides a satisfactory display. Also, using internal sweep on an oscilloscope means that synchronization is achieved only rarely and that the display is often a confused jumble. With my television display, I have a separate signal from my synthesizer for the left and right channels to the television display and I can actually play the display by selecting sounds from the synthesizer oscillators that produce the most interesting patterns.

I watch the display as I play the synthesizer and work for interesting visual results as well as interesting aural ones. The combination of the two stimuli makes the result much more interesting to the audience, I find, as the two reinforce each other. An interesting visual pattern will attract attention to the sound and *vice versa*. Playing on such an audio-video synthesizing system is an experience as well—both senses are titillated with effects that are deliberately controlled by the performer. In the usual "light show" such combinations are left to chance because the music or other sound is prepared in advance without consideration of visual effects.

By connecting three different oscillators and other generators to the X, Y and Z channels of the television set, it is possible to generate some very spectacular animated displays. It seems that low-frequency oscillators create this sense of animation best. They may be mixed with higher frequencies, or, better yet, frequency-modulate higher frequency oscillators so that the result is a switching of patterns at fixed rates. Such circuits as voltage-controlled oscillators, ring modulators and electronic metronomes may be used to advantage to create interesting patterns and motion. Anyone having a synthesizer will find that such a display adds a considerable new dimension to its enjoyment.

WATCHING RECORDS

It may make a good joke, but with such a system you can tell your friends that you are going home to "watch a few sides!" Seriously, many records produce spectacular visual results and you may find yourself going through your record collection to see what sorts of effects you can discover. As pointed out earlier, changing phase relationships between the channels cause patterns to rotate on the screen at the speed of the phase shift. Also, since the ear responds to the logarithm of the amplitude (the decibel scale) in its perception of loudness, while the video display responds to the amplitude directly (in the form of voltage), a very small change in loudness can produce a large change in the size of the display. The display can be a very vivid replica of the sound as a result, calling attention to the smallest details.

Since one channel produces vertical deflection and the other channel, horizontal, a combination of two channels carrying the same signal, in phase, produces one diagonal and, out of phase, the opposite diagonal. Thus the device serves as a good indicator of channel separation. It would be possible with some differential amplifiers and a resistor matrix to convert the display to a four-channel display of the sort employed in some audio equipment. It would also be possible to display matrix quad records to see the in-phase information and out-of-phase information. But that's another project, beyond my intentions at this time. ■