COMMUNICATIONS CORNER

A digital-delay system for communications

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EVEN AFTER YEARS OF RECORDING EXperience, it still takes studio technicians some time to adjust to the disorientation caused by hearing a performer's voice a few seconds after his lips have moved. If you are not used to that loss of "lip sync," your first experience with it can be particularly discomforting. What causes it, of course, is tape-playback delay; it can be rather amusing once you get over the initial shock.

But what about hearing sound *before* the performer's lips moved? Imagine if you will, a romantic scene in a movie—the male lead looks deeply into his girl's eyes, and through clenched teeth whispers "I love you!," followed by dead silence while he yawns. That used to happen in the old movie houses of thirty and forty years ago; the well-worn film sprockets of their broken-down projectors would lose the sound loop, and the sound would precede the action. I often heard the shot of Gene Autry's gun before it even cleared the holster. (I always wondered how come he didn't hop around after blasting himself in the foot!)

While we've come a long way from those early projectors that literally chewed up film, and we now use computerized continuous-loop film projectors, we have not entirely eliminated sound that precedes the action; we simply do it with high technology and use a satellite to mess things up.

Until recently, television programs were relayed using two modes: the video was sent by satellite and the audio by landline (telephone). The signals were recombined at the receiving end of the relay circuit. There were several reasons why that was done; among them were cost and problems with digitizing the audio. Today, both the video and audio television signals are sent primarily by satellite, but for certain applications, such as teleconferencing, it's still less expensive to use the older technique.

The only problem with splitting the signals, however, is that the audio gets where it's going ahead of the video, because the video travels a longer path. Let's take a look at Fig. 1. As you can see, the video must not only travel up to the satellite, it must also travel back down to the receiving station. The audio, on the other hand, travels a much shorter path (even if you account for the fact that the path is unlikely to be a straight line). The difference is usually great enough that the audio will arrive at the destination slightly ahead of the video, even though both are traveling at the speed of light. How much the video is delayed will vary with the difference in length of the two paths, although 250 milliseconds is considered average. Although that may not sound like much, it's enough to be disconcerting—the cowboy's gun will again be firing before it clears the holster.

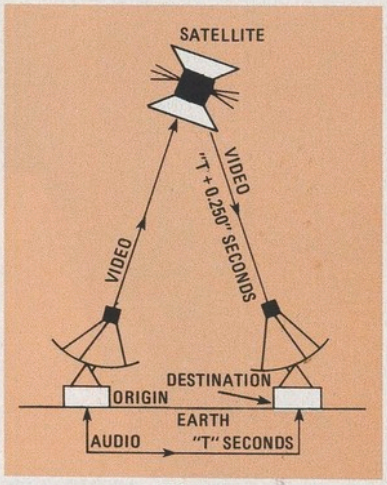

FIG. 1

FIG. 2

One way to eliminate that problem is to delay the audio somehow so that it arrives at the same time as the video. That can be done using a computerized digital delay such as the *model BD955* digital delay-line from Eventide Clockworks (265 West 54th St., New York, NY 10019) shown in Fig. 2.

That device was not originally intended for use with satellite-TV (although they presently manufacture equipment specifically for that application). Its primary purpose was to delay the broadcast of call-in-type radio programs; a problem with those shows is that sometimes the callers try to say things they shouldn't. Many radio stations protect themselves (if an obscenity is broadcast, the station, not the caller, would be in trouble with the FCC) by using a tape-loop delay device. The program is recorded on a 7-second tape loop. The recorder's playback head is located right before the erase head, rather than after the record head. The signal to the transmitter is taken from the playback head rather than fed "live." That introduced a 7-second delay between the live action, and the broadcast; enough time to interrupt the show if something embarrassing is said. After the recording is broadcast, the tape is erased and reused.

As you might expect, the whole procedure, including the durability of the tape loop and mechanism, leaves something to be desired. The obvious solution is to use a digital delay.

A block diagram of the Eventide delay is shown in Fig. 3. In that system, the audio is first digitized, and then entered into a memory. As successive pieces of the audio signal are entered, the first entry is pushed along, bucket-brigade fashion, until it appears at the memory's output. The output signal can be taken from different points along bucket-brigade memory. The actual point where the output is taken determines the amount of delay. The memory output is then fed to a D/A converter, eventually producing an analog output that's an exact replica of the input, only delayed.

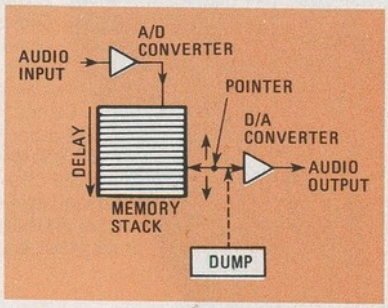

FIG. 3

In that particular system, the amount of delay is set at 6.2 seconds for radio

"talk-show" applications. A MANUAL DELAY control lets you adjust that to suit various other applications. The proper setting for a 250-millisecond delay (for satellite applications) is clearly marked.

Let's get back to how that device is used in radio. At this point you should be asking how the radio station gets rid of an undesirable phone call. That is where the dump function comes in. On the front panel there is a switch labeled DUMP when pressed it instantly flushes the memory of all data and sets the delay to zero. An internal relay then disconnects the phone call.

As the announcer, now broadcast live, talks, the digital-delay line begins to advance the read pointer slowly, actually stretching the waveform. It is done so slowly and efficiently that it is unnoticeable on speech; only a trained listener would detect the change with music. After about 1 minute or so—time that could be filled with a commercial or some comments from the announcer —the delay has built back to its full 6.2 seconds, without anyone noticing.

There you have it. In case you are wondering, the sound quality of digitized audio is very good. Two versions of the unit are available. One, with a response of 7500 Hz is for AM or telephone applications; the high-fidelity version has a 15-kHz response. **R-E**