Engineer's notebook

Time-shared analog bus multiplexes audio signals

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A multiplexed analog bus can be easily realized by means of complementary-MOS analog switches and rudimentary sample-and-hold circuits. Thus the advantages gained by the time-division multiplexing of digital signals—mainly the multichannel sharing of processing hardware—may be also secured for audio waveforms.

Each analog driver output is connected to the bus through an analog switch. Each analog receiver input is attached to the bus via a simple capacitor/operational-amplifier sample-and-hold stage. As each output is switched onto the bus, the corresponding inputs it is connected to are also engaged. During this aperture time, the hold capacitors are charged. The specific input/output map is stored in a random-access memory. If a computer is available, a memory-mapped scheme lets the user implement changes easily and affords convenient cataloging of any patch on a mass-storage device.

C-MOS analog multiplexers serve as the central switching element in the four-channel multiplexer shown in Fig. 1. These devices are bidirectional and have separate TTL-level address inputs, enabling the switching of analog input signals in the range of ± 5 V.

The bus technique is not confined to a four-input multiplexer, of course, and many other configurations can be constructed. Figure 2 shows a design using discrete analog switches and a summing amplifier that mixes 16 unique sums of outputs to any number of 16 inputs. Multiplexing is done at 62.5 kilohertz in this case (47 kHz if an additional 250-nanosecond settling time is permitted). This sampling frequency is sufficient to process audio signals below 20 kHz without significant distortion. When tape recording and other baseband equipment is used, a low-pass filter will be required to eliminate the switching noise that is generated. □
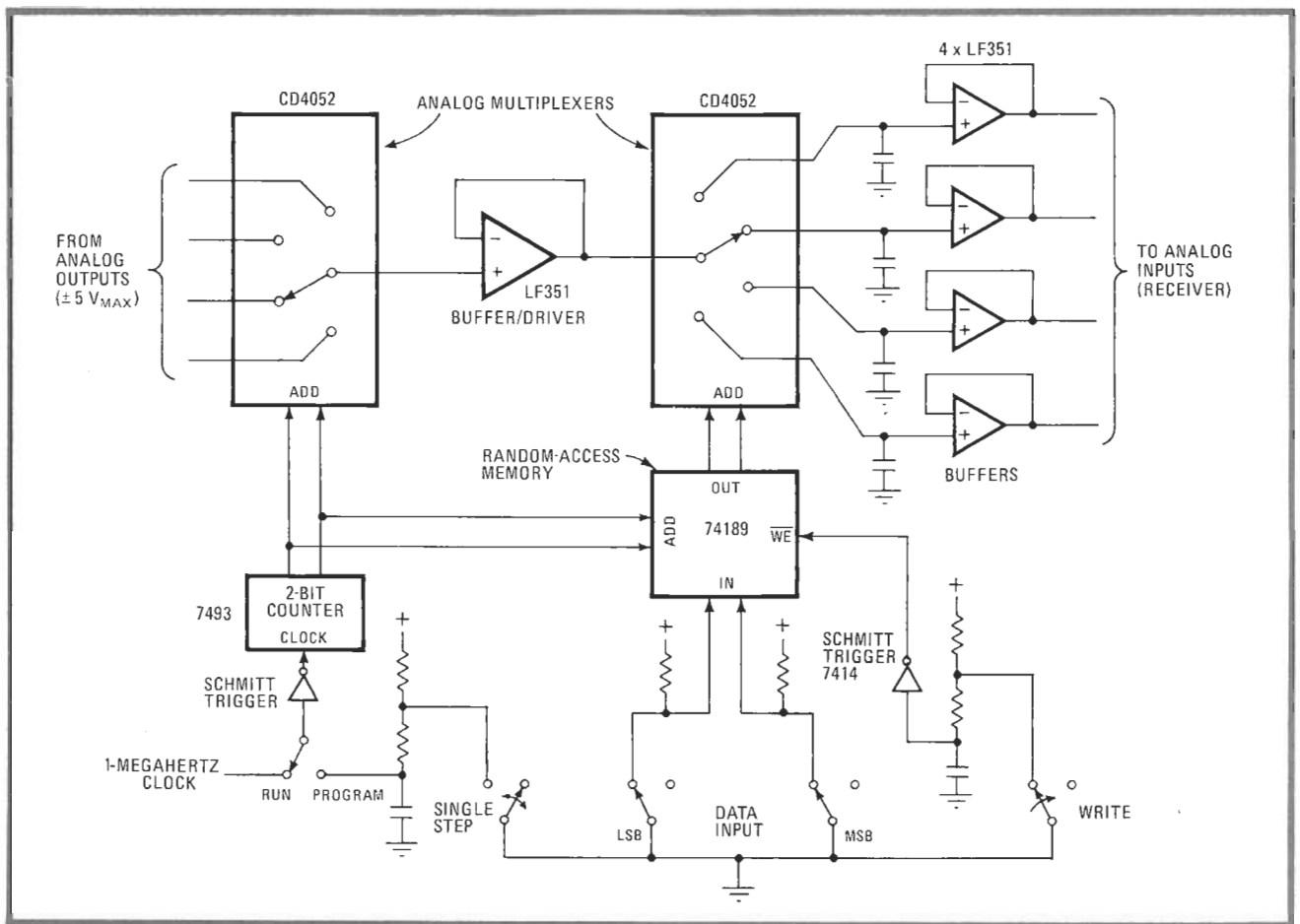
1. Four by four. Analog multiplexers combine four analog signals over a common bus. Counter, driven by 1-MHz clock, sequentially selects analog outputs and sends signals over bus to receiver. RAM containing input/output map delivers signals to required port.
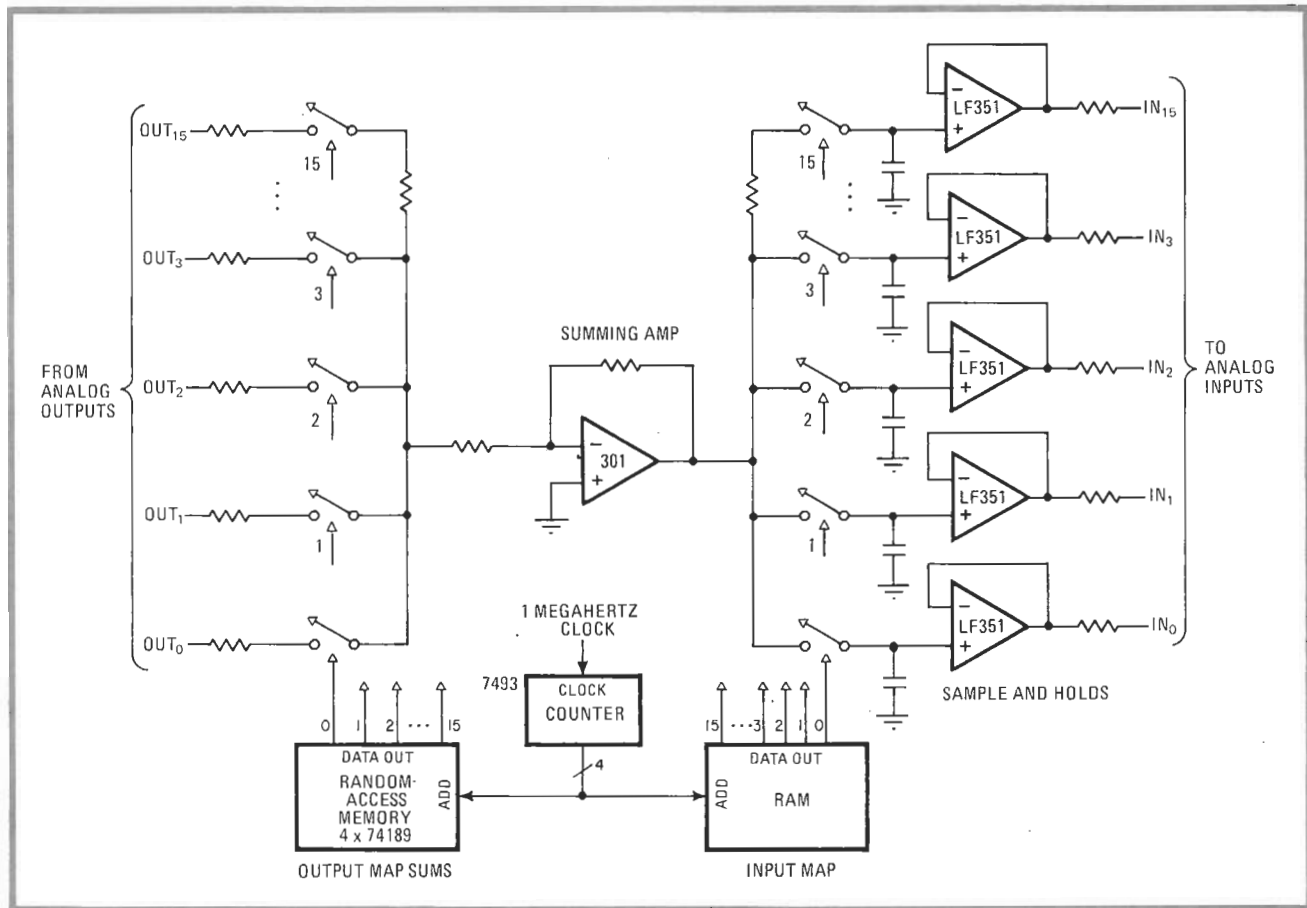
2. In summation. Two RAMs and discrete analog switches enable multiplexer to deliver up to 16 sums of outputs to any number of 16 receiver inputs. Number of sums is proportional to length of RAM. Multiplexing is done at 62.5 kHz to ensure coverage of audio band.