Court Room Demonstration System
1969 AL1 Microprocessor

4/3/95

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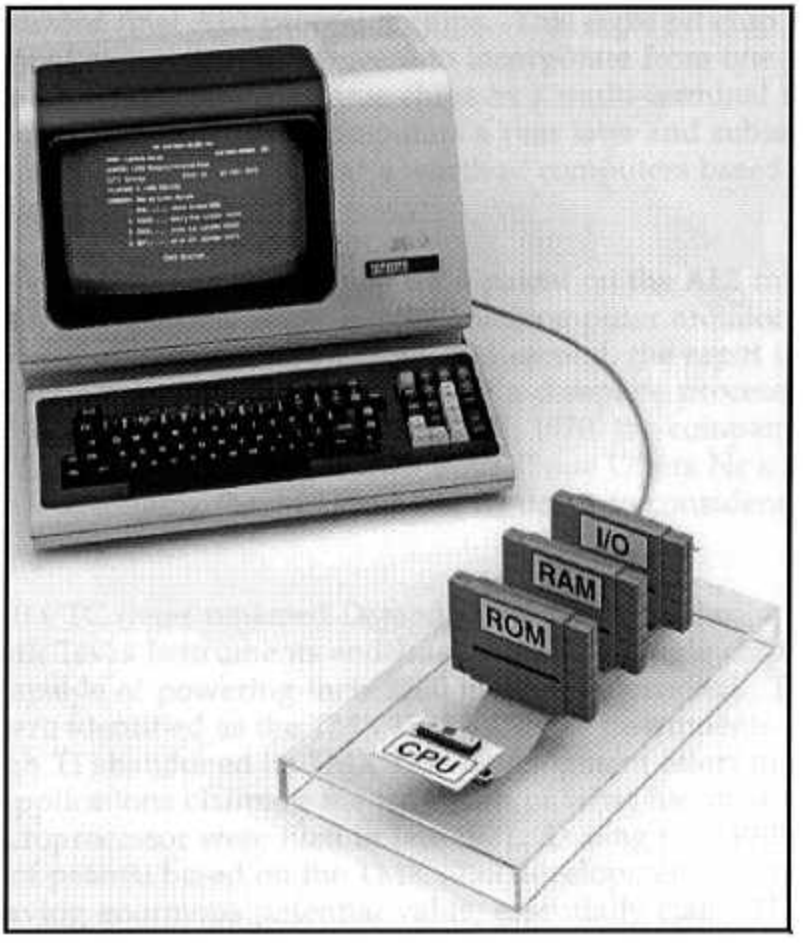

The AL1 computer model described herein was developed to demonstrate the capability of a single 1969 vintage AL1 microprocessor chip to be combined with an external memory to form a complete operational computing system. This model, which includes system and application software suitable for court room demonstration, is intended for use in litigation relating to the invention of the microprocessor. The particular system configuration was chosen to satisfy the 1970 computing requirements of companies such as intelligent terminal manufacturer CTC (Datapoint) as well as claim elements of a number of microprocessor computer patents.

Background

In late 1968 Four-Phase Systems Inc. was founded with the objective of creating the first VLSI computer system. Work began on the AL1 processor chip, the heart of the company's computer family, in October of 1968, and in April of 1969 the company demonstrated final AL1 processor chips. This eight bit chip was designed for use in a family of computers which were to incorporate from one processor chip in a single terminal configuration to three chips in a multi-terminal server. Four-Phase began shipments of AL1-based computers a year later and subsequently shipped approximately one billion dollar's worth of computers based on this original AL1 design.

Four-Phase decided against applying for a patent on the AL1 microprocessor chip in 1968 for several reasons. First, similar minicomputer architectures were well documented and understood at the time, and second, the rapid increase in component densities made the implementation of a complete processor on a single chip both inevitable and obvious. Instead, in April, 1970, the company published a tutorial article in Computer Design entitled, "Four-Phase Offers New Approach to Computer Design", describing the AL1 chip and its usage in considerable detail. See Attachment 1.

In mid 1970 CTC (later renamed Datapoint), a Four-Phase competitor, requested that both Texas Instruments and Intel develop a single chip microprocessor capable of powering their 2200 intelligent terminal. The two resulting chips were identified as the TMX 1795 by Texas Instruments and the 8008 by Intel. Although TI abandoned its TMX 1795 development effort in early 1972, a series of patent applications claiming the invention of what has now come to be known as the microprocessor were filed in late 1971. During the 1970's and early 1980's a number of patents based on the TMX 1795 development were awarded to TI. These patents, having enormous potential value, essentially claim TI as the inventor of the present day microprocessor and cover such industry standards as the 386, 486, Pentium, and 68000 microprocessors.

These patents, however, appear to include circuit technology described in a series of Four-Phase articles, including the AL1 tutorial, published in early 1970. None of these Four-Phase articles appear to have been supplied to the patent office as part of the prior art disclosure. Acknowledging the well documented AL1 development chronology (Figure 6), TI reportedly has taken the position that the AL1 chip cannot operate independently and that it requires additional control logic (other than external memory) to function as a computer system. Thus, it is claimed, the AL1 is not a "single chip" microprocessor as described in their patents. This position appears to be clearly incorrect. The article describes a multi-state AL1 chip capable of performing as a single, stand alone, 8-bit processor, as well as in multiples, which offer improved performance.

While both sides will undoubtedly retain technical experts prepared to debate the architectural complexities of various microprocessor and AL1 designs, it is doubtful that the average person or jury member will be able to understand these technical arguments. A simple solution for cutting through the technical jargon, of course, would be to construct a simple demonstratable computer system, featuring a single 1969 vintage AL1 chip, capable of performing the same computing tasks as TI's 1795 and Intel's 8008 and satisfying all claim elements of the contested patents. Such a system is described below.

Demonstration Model

Demonstration software selected for the model includes a data base program for entering, updating and searching customer records. Similar "fill in the blanks" data entry software was typical of applications intended for intelligent terminals such as CTC's 2200 during the 1970's. This data base demonstration includes a key software program (WSTR), developed by CTC in 1970, which was used to transfer complex strings of computer text and control information from CPU memory to the 2200's video display. This software program, which is described in Attachment 2, was reportedly made available to TI to help to verify proper operation of their chip design. Video screen images of the main menus as well as operating instructions and a sample customer record for this program are shown in Figures 4 & 5.

The physical demonstration model contains four distinct sections which correspond directly to the four functional blocks identified in microprocessor patents issued to TI. The main block diagram, as it appears in these patents (Fig. 1), identifies a CPU, ie. the TMX 1795, an external ROM, an external I/O, and an optional external RAM, all interconnected by a bus. Figure 2 constitutes the overlay of component elements present in the AL1 demonstration model on this block diagram. A more detailed interconnection diagram of a minimal AL1 system appears in Figure 3, which includes the "Fig. 6" (page 144) diagram from the April, 1970, AL1 article.

The external memory, containing the Customer Record demonstration program, is enclosed in a rugged interchangeable cartridge similar to those used to store ROM game programs for Nintendo video game sets. Similar cartridges were used to house the optional RAM memory and the I/O interface circuit. A single exposed AL1 microprocessor chip (actually manufactured in 1969) is mounted on top of a connection to a flat ribbon cable bus which interconnects the four modules. The clear plastic box used to support the four modules contains no other electronics, and its only interconnections are those to a small external power supply and the RS232 telephone wire which is connected to a dumb video display terminal. A labeled overlay of the AL1 demonstration model's ROM, RAM, and I/O printed circuit boards appears in Figure 10, and a color microphotograph of the AL1 chip appears in Attachment 1.

Figures 7 and 8 are photographs of the demonstration model showing the three external cartridge modules in line behind the AL1 CPU chip. These modules are labeled ROM, RAM, and I/O and correspond to the three external elements identified in the patent diagrams. The model was designed to operate with a twenty year old DEC VT52 dumb video display terminal (Fig. 9) which is functionally identical to CTC's dumb video display designed in 1970. System software for the AL1 demonstration model, including the assembler, macro assembler, and loader appears in Attachment 3. The Customer Record application software program for the AL1 demonstration system is included in Attachment 4.

This model also demonstrates that the AL1 was capable of running software such as the WSTR program over 10 times faster than either the TMX 1795 or the 8008. This performance advantage was the major reason that Four-Phase refused requests to sell individual AL1 chips to competitors such as CTC (Datapoint). See Attachment 2. Intel's 8008 was actually the first commercially available, full function microprocessor chip and was followed shortly thereafter by the extraordinarily successful Intel 8080, which ushered in the era of the high volume microprocessor. A brief developmental chronology of the AL1, 1795, and 8008 appears in Figure 6.

Conclusion

Since the AL1 microprocessor chip was operational two years before microprocessor prototypes were deliverable to CTC by either TI or Intel, it is difficult to understand why a group of patents covering the design of the basic microprocessor was awarded to TI.

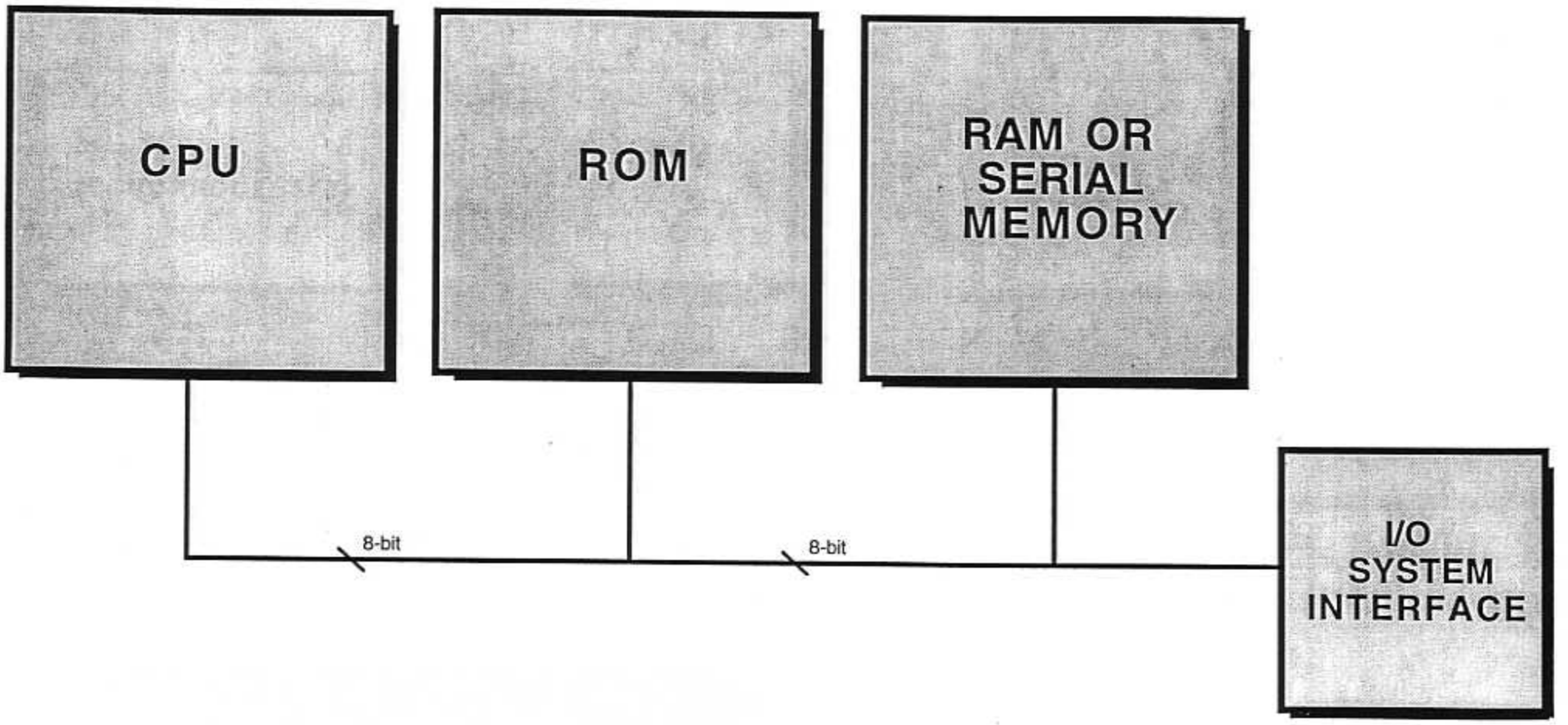

Figure 1. Main system block diagram from microprocessor patents 3,757,306, 4,037,094 , and 4,503,511. The patents identify the TMX 1795 as the CPU block in the diagram.

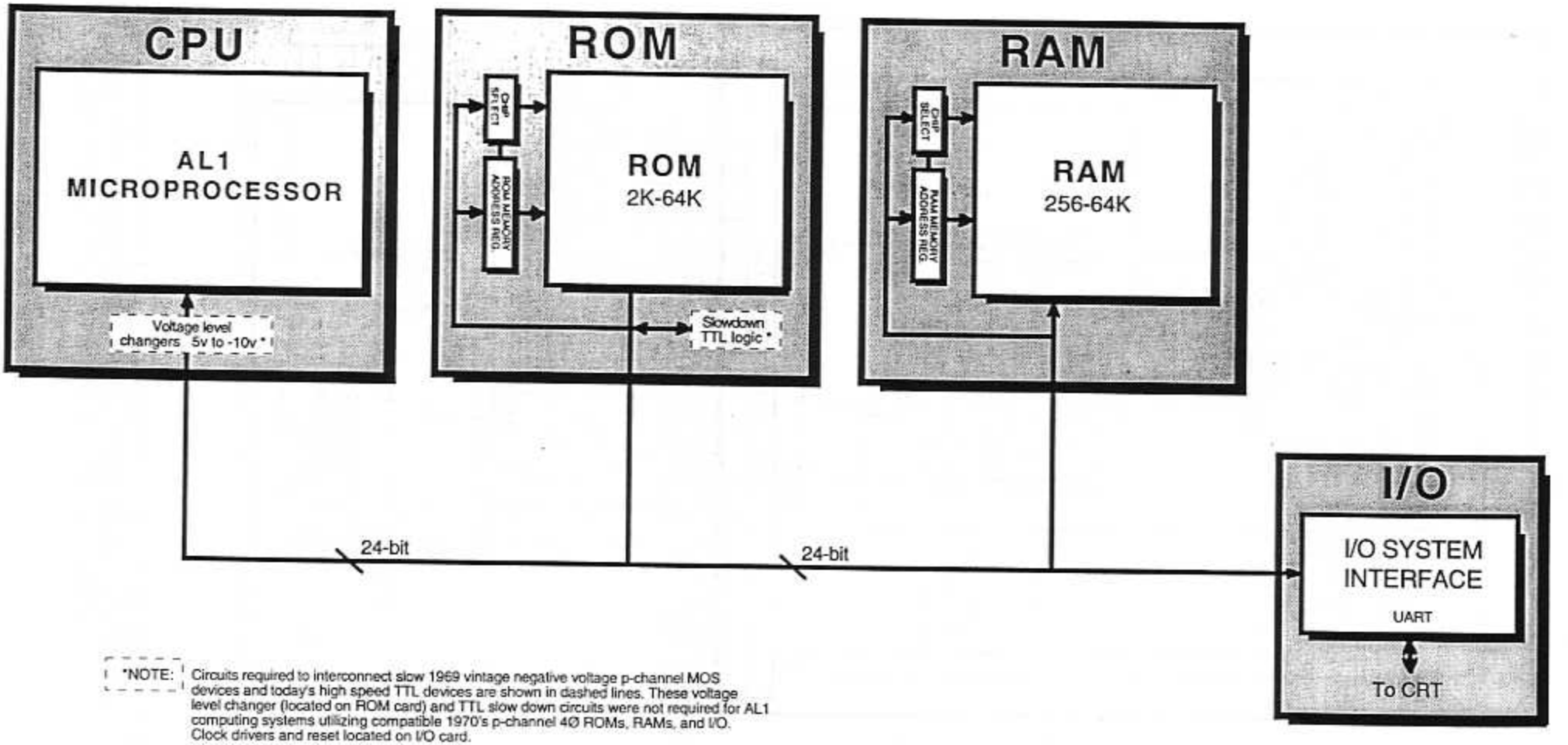

Figure 2. AL1 single chip computer system. Component elements of the AL1 demonstration system are shown in one to one correspondence with the block diagram elements found in the computer patents described in Figure 1.

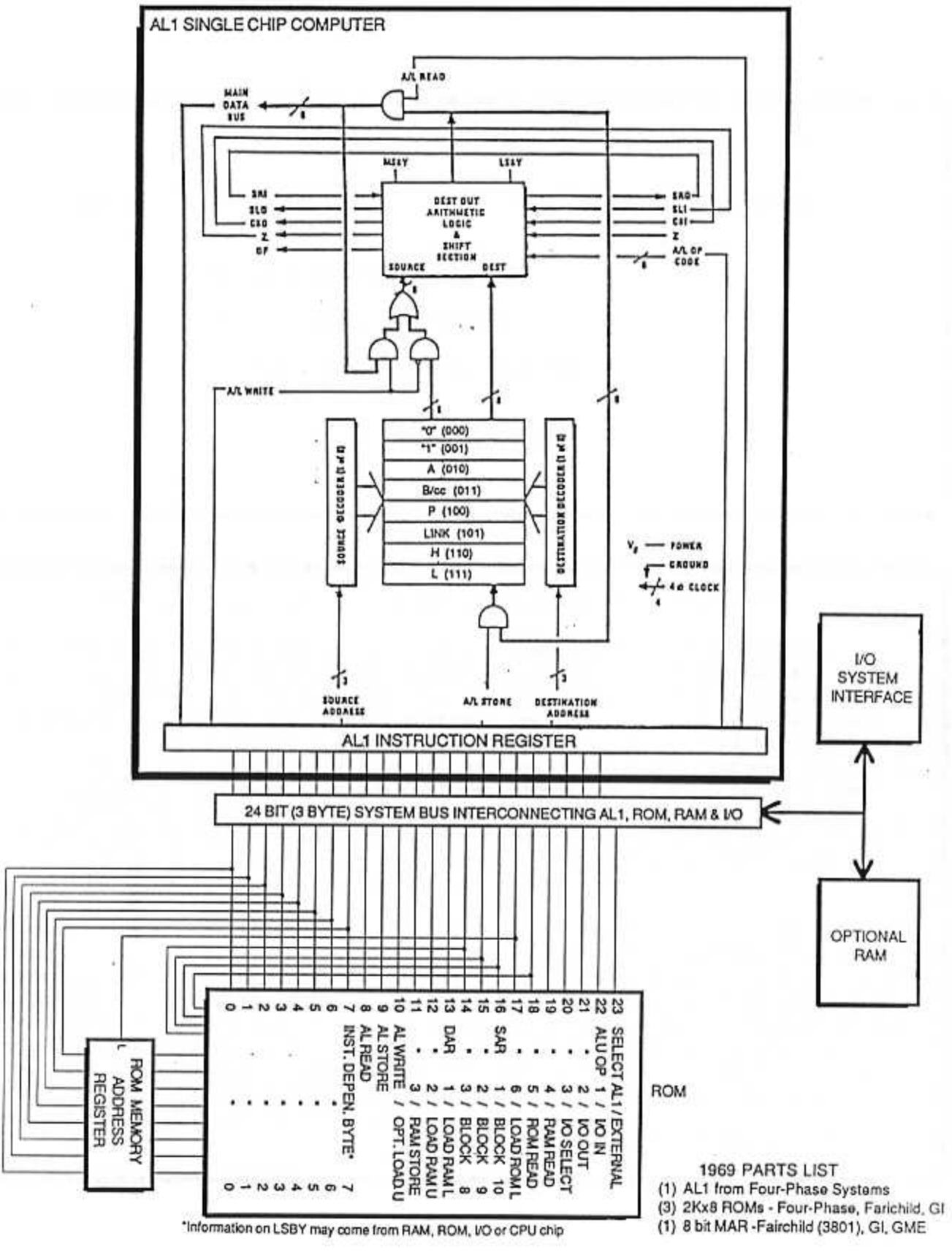

Figure 3. Interconnection diagram of minimal AL1 computer system. The four functional blocks (CPU, ROM, RAM, and I/O), corresponding to Figures 1 & 2, are shown interconnected by a single 24 bit bus. The AL1 block diagram at top of page appeared in the April, 1970, AL1 article (page 144).