

be displayed in binary by LED's.

4. **EXAMINE NEXT:** Steps the P counter once and displays the word stored at the next location.

5. **DEPOSIT:** Causes the information preset by the switches to be stored in the memory.

6. **DEPOSIT NEXT:** Stops the P counter and loads the memory.

7. **SINGLE STEP:** Steps the program one instruction.

8. **RESET:** Clears the CPU and sets up a starting address of 0.

9. **CLEAR EXT:** Clears all input/output devices; occurs automatically when power is turned on.

10. **PROTECT/UNPROTECT:** Allows selective protection/unprotection of blocks of memory. When a block of memory is protected, it is impossible to write over that block, but its contents can be read out.

There are 36 LED status indicators on the front panel, 16 of which are used for the address buss, 8 for the system status latches, and 8 for the data buss. The four remaining LED's are used for indicating memory-protect, interrupt, system-wait, and hold status.

**Power Supply.** Four power sources are required to operate the computer: +5 volts at 2 amperes, -5 volts at 500 mA, -12 volts at 500 mA, and +8 volts at 6 amperes. The first three are regulated, while the last is unregulated. The three regulated lines power the processor. The unregulated line powers the peripheral cards that can be used to expand the system, each of which has its own 5-volt regulator on board. This reduces electrical noise and obviates the possibility of total system failure due to the failure of only one regulator.

**Expansion.** The basic computer is designed for almost unlimited peripheral and memory expansion, using a buss system where all input/output connections merge into a common line. Hence, an external card can be plugged into any slot and it will function properly. The only qualification is that each card have an address decoder to allow the specific card to take what data it needs from the common buss and put data on the buss as required. The processor buffers are designed to drive 300 external cards, which should be adequate for most applications. Bear in mind that only 17 cards will yield 65,000 words of memory.

[Editor's Note: At this writing, a number of different peripheral devices

are in various stages of design or undergoing tests]

**Assembly Details.** The basic computer employs four printed circuit board assemblies, each of which contains one functional element of the basic system. Because the boards are large and very complex, we are not publishing etching and drilling guides or component-placement diagrams. Instead, you can obtain a set of guides, diagrams, an instruction set, buss points, and miscellaneous information by sending a stamped self-addressed 8½" x 11" manila envelope with 40c postage to MITS, Inc. (See note below Parts List for address.) Request the PE8800 package.

The front panel display board accommodates the 36 LED indicators and their associated drivers. Address line inputs A0 through A16, data lines D0 through D7, and the various status lines originate on the CPU board. The boards have been designed so that the

various mating pads on both are aligned. Multi-conductor flexible ribbon cable interconnects the boards.

The front panel control board contains the circuitry for the interfacing between the control switches located on the front panel and the CPU. In addition to the interconnections to the actual processor, this board accepts memory address switches A0 through A15 (also on the front panel). The first eight of these switches (D0 to D7) are used to put data into the CPU. The EXAMINE/EXAMINE NEXT, DEPOSIT/DEPOSIT NEXT, SINGLE STEP, and RUN/STOP switches are also wired directly to the front panel control board.

The third board contains the Intel 8080 central processing unit LSI chip, two-phase clock and buffers, and the various lines going to the buss. (The buffers are tri-state, high-input-impedance, high-output-level devices.) This board also has four dual-D flip-flops wired as latches for the eight bits of status information. All input and output wiring to and from the CPU board is via a 100-line buss.

The basic memory board contains 256 eight-bit words of random access memory (RAM). It is directly expandable to 1000 words. This board also contains the input/output data-gating, address-decoding, memory-wait, and memory-protect circuits. The memory-wait circuit allows the memory time to stabilize the output data to the processor, while the memory-protect circuit prevents accidental overwriting of the memory. All connections between the CPU and the memory board are via the 100-line buss.

The four boards, along with the power supply, mount in an 18-in. deep by 17-in. wide by 7-in. high (45.7 x 43.2 x 17.7-cm) metal cabinet. The various operating switches and LED indicators go on the front panel. When all this is done, the computer cabinet's interior will appear to be almost empty. However, the internal cabling system is arranged with connectors to accommodate 17 more boards within the case, all connected to the main buss lines. The added boards can be used for memory, input/output devices, control devices, etc. All you have to do is plug the boards into the connectors and the computer does the rest.

Part 2 of this article, next month, will describe the operation of the computer and present some sample programs.

#### SOME APPLICATIONS FOR THE ALTAIR 8800 COMPUTER

Listed below is only a small sampling of the thousands of possible applications for the computer. The Altair 8800 is so powerful, in fact, that many of these applications can be performed simultaneously. It can be used as a:

- Programmable scientific calculator
- Multichannel data acquisition system
- Automatic control for ham station
- Sophisticated intrusion alarm system with multiple combination locks
- Automatic IC tester
- Machine controller
- Digital clock with all time-zone conversion
- High-speed I/O device for large computer
- Digital signal generator
- Automated automobile test analyzer
- On-board mobile controller
- Autopilot for planes, boats, etc.
- Navigation computer
- Time-share computer system
- "Smart" computer terminal
- Brain for a robot
- Pattern-recognition device
- Printed matter-to-Braille converter for the blind
- Automatic drafting machine
- Automatic controller for heat, air conditioning, dehumidifying
- Controller for sound systems
- Digital filter
- Signal analyzer