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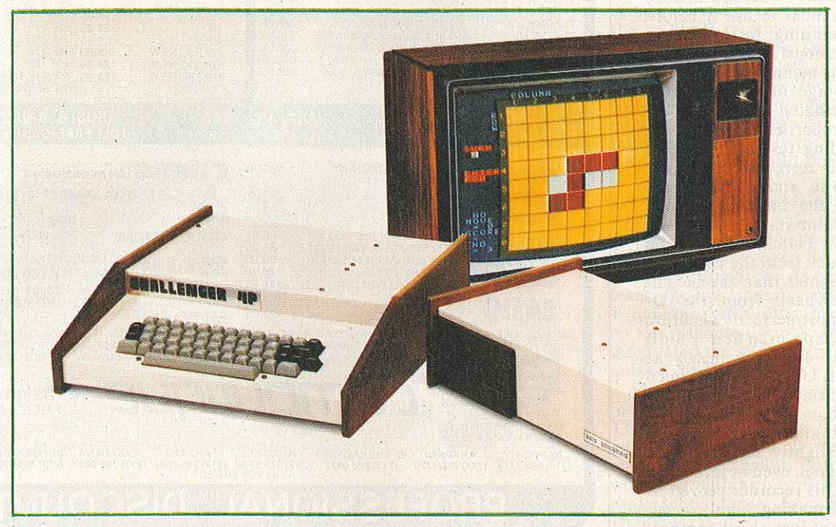


Ohio Scientific's Challenger Model C4P-MF Microcomputer

ON ITS capabilities alone, Ohio Scientific would have been justified in naming the Challenger Model C4P-MF microcomputer the "I/O Machine." An outgrowth of the basic Model C4P, a $698 computer, the MF version reaches new dimensions of utility through its numerous input/output provisions and other useful special features.

The rear panel tells much of the story. It has 16 parallel I/O lines, RS-232 ports for a 300-baud modem and a 300/1200-baud printer, an interface for fire and intrusion detectors, a real-time clock, and an accessory bus connector for an external 48-line I/O board, PROM blaster or whatever. And there's a GT option that nearly doubles the C4P-MF's speed, which is already twice that of the basic C4P. Also, the C4P-MF uses a mini-floppy for mass storage, in contrast to the cassette used in the C4P. In addition, the computer has keypad interfaces, joystick interfaces, voice and music generation, a built-in audio amp, an ac remote-control interface, and a full-color display system.

As it comes, the C4P-MF incorporates a single mini-floppy drive (with BASIC on disk) and a minimum of 24K of RAM. Moreover, it can be expanded to 48K RAM and two mini-floppy drives. With its 53-key keyboard, the computer main frame is no larger than an office typewriter (17½" W × 16¼"D × 4½"H). The disk drive measures 14½"W × 10"D × 4½" H. Suggested retail price is $1799 for the 24K version, $2199 for the 48K version.

Hardware Description. The C4P-MF is built around a 6502A microprocessor, the same one used in the PET, Atari and Apple computers. This CPU is known for its speed and somewhat limited addressing modes. In the OSI system, the clock rate is 2 MHz, slowed to 1 MHz during cycles that reference the monitor ROM.

In its minimal configuration the Challenger contains 24K bytes of RAM. When the video display accessory is included, an extra 2K bytes is added to manage the screen. Since the display area is memory mapped, it can be addressed as part of the main memory and used by programs. OSI advises that this will "mess up the display." The 24K of RAM resides on a separate pc board and is implemented in 2114 static RAM chips. Static RAM chips are not prone to the soft errors sometimes found in dynamic RAM chips. Therefore, circuitry for error detection and correction is not required. A socket for a 2716 EPROM, the largest the address lines can handle, is provided on the CPU board.

Mass Storage. A 5¼" disk drive using single-sided, single-density, soft-sectored (one index hole) diskettes provides mass storage for the C4P-MF. Each diskette can hold 79,872 bytes, and a second drive can be added as an option. No cassette interface hardware is provided.

Display. A raster-type, conventional TV scan is used. The composite video output from the computer is 1 volt peak-to-peak. Source impedance is about 22 ohms, and the manual recommends the use of a high-input impedance monitor. The display is

organized as 64 characters per line, and 32 lines per screen. Under software control, the number of characters per line may be reduced to 32 for better legibility on an unconverted TV receiver. The position of the display on the raster is fixed, and although a good horizontal margin is left, the vertical margin is not enough to prevent the top line from appearing "above" the viewable screen. Some slight ringing and overshoot can also be observed in the display.

Characters are created in a matrix eight dots by eight lines with the lowest cell line blank, except when a descender is used. As the lowest cell line abuts the topmost line of the character cell below it, the descender will merge into the character below. Commas and semicolons do not project below the baseline of their cells.

The dot rate of 13.5 MHz requires a monitor video bandwidth of 6.75 MHz for optimum display of 64 characters per line. Such a bandwidth is usually available from a monochrome monitor and modified TV receivers in which the 3.58-MHz (chroma) and 4.5-MHz (sound) traps have been bypassed or disabled.

Of the total of 256 characters (including space) contained in the character-generator ROM, 96 comprise the full ASCII alphanumeric set. The remaining 160 are patterns that can be combined to create graphics. No software-writable character set is available, and no hardware is provided for cursor generation. BASIC uses an underscore character that cannot co-exist with another character. A cursor effect is possible by setting a color over one or more characters. This is subject to the limitations imposed by the color subcarrier (which can produce an annoying "dot crawl" over a monochrome display).

The C4P-MF can, under software control, be set to a color display mode, in which each character position has a four-bit color number (in memory) associated with it. Three of the bits specify the color (any of seven hues, black, or the hue overlaid with black), while the fourth bit specifies whether the character or the background is to assume the specified color. If the video assumes the color, then the background becomes black, and vice versa. Colors may be used in any order desired. The color of the rightmost character background is continued to fill the screen as the background color for the entire raster.

This background color extends right up to the following horizontal sync pulse, which, at a width of 4.5 μs, is within NTSC specifications. At variance with the NTSC specification, the 3.58-MHz color-reference burst starts right at the trailing edge of the horizontal sync pulse, rather than with the slight (380-ns) delay specified by NTSC. Also, the color burst has its negative peaks rather than its zero level coincident with the pedestal (back porch) of the horizontal sync. Since the back porch is assumed to be the blanking level and there is no gap between the end of the burst and the video line, there is no blanking level "set-up" reference. In some receivers, this may cause poor operation of the sync, agc and chroma circuits.

Keyboard. A 53-key, typewriter-like keyboard is used in the C4P-MF. Layout is standard, with offset keys, sloped profile, and matte keytops for reduced reflections. Auto repeat is provided.

Conventional alphanumerics use 42 keys, 8 are used for control functions, and one is the "break" key that transmits no character, but instead resets the CPU. All keys are software defined and any number of them can be held down at once and detected. The keytops are not marked with control characters or characters such as left arrow, right arrow, at-sign, etc. The equivalencies of shifted characters and their functions must be dug out of the manual—where they are not clearly given.

"... this computer offers easy entry to the field and lots of room for exploration."

To operate the system bootstrap, one must depress the shift-lock key. This may seem awkward, but it is a valuable safety feature.

Input/Output. A serial communications port with two connectors, one for a printer and the other for a modem, serve the C4P-MF. Both cannot be used at once. The voltage levels do not meet RS-232 standards, but represent a compromise between the need to include a separate negative power supply and the fact that most serial devices can accept signals that range between 0 and +5 volts. RS-232 inputs on some peripherals may include a pull-up resistor to hold a disconnected input in the high state. The low logic level of the C4P-MF's serial output is produced by a resistor to ground, so the current sourced by pull-up resistors could produce a permanent "high" indication.

The ACIA (a form of UART) used in the serial port will inhibit its transmitter-empty flag if the CTS (clear to send) signal is not presented to it. This signal, supplied from the printer port as the C4P-MF is shipped, can be jumpered to a permanent "ready" condition.

Baud rates are selected from a range of 75 to 9600, and a 110-baud setting is not provided (this precludes use of a TTY as a hard-copy printer). Only two baud rates (with one four times the other) can be selected under software control. As the unit is shipped, the baud rates are 300 and 1200. Accuracy is 99.84%.

Two parallel ports driven by one PIA (peripheral interface adapter) are provided. By means of software, the 16 bits can be independently configured as inputs or outputs. Only data bits are present and no strobe bits that will set interrupts are provided. Thus, the program must test the status of bits from the external device to determine if a flag signal is presented. This means that latching and handshaking must be externally performed.

The PIA outputs are capable of sinking 1.6 mA in the low logic level and sourcing 1.0 mA at 1.5 volts in the high state. This restricts the maximum termination load to 1.31 kΩ returned to 2.5 volts. This does not permit the use of terminated transmission lines for long interconnections. Maximum cable length that can be driven by these outputs is about 10 feet (3 meters).

In addition to the PIA, a set of buffered data lines is brought out to a socket on the rear panel that can be connected to an external PIA (or its equivalent). The sockets for these signals, as well as the PIA ports, are conventional 16-pin DIP types suitable for IC's but not the most durable I/O connectors.

Eight resistors, arranged in a divider, form an eight-bit resistive D/A (digital-to-analog) converter. These resistors, accurate to within 5%, make the smallest variation possible under program control 0.4% (1 part in 255). Output precision is 5%. Because of an output coupling capacitor, low-frequency response of the D/A is −3 dB at 9.5 Hz. Conversion speed is limited by program execution.

The D/A converter can be turned off under software control and the built-in tone generator turned on. This generator, operating between 20 Hz and 20 kHz, provides a square wave whose frequency is divided down from that of a master oscillator using any of 256 divisors selected via software. Direct memory access (DMA) is not possible with the C4P-MF, since the address drivers are permanently enabled.

The two joysticks provided in the C4P-MF package are conventional in

use in that their movement controls that of an on-screen object, while depressing the joystick button controls another action. However, since the software keeps testing at the joystick port at all times, and the two joysticks are equivalent to an active keyboard when out of their "neutral" positions, false data can be incidentally input. This can "bomb" the program before it starts to run. The external 10-key keypads are the equivalent of a conventional numeric cluster as used in many terminals and computers.

Also quite useful is the remote-control option (a modified version of the BSR X-10 home wireless control system), whose command console can handle up to 16 channels of lights and/or appliances. As supplied by OSI, the package includes two modules for appliances and two for lights, along with appropriate software. In order to prevent remote-control interrupts from wiping out BASIC programs that may be running, the first statement of a remote-control program should save the current BASIC program on diskette. That way, its execution can be resumed after the interrupt is serviced.

Power Supply. The C4P-MF operates from 120 V ac and a separate power line and switch are provided for the disk chassis. Series-pass regulated power supplies are used: two in the C4P and one in the disk drive. The supplies in the computer chassis were loaded to 1.6 amperes of excess current before their regulators automatically shut down.

Both the C4P-MF and the disk were powered from a variable autotransformer and the line voltage was lowered at approximately 0.1-volt ac per second to simulate a power-line "brownout" condition. No ripple appeared on the video display until 85.3 volts rms was reached, and the program—which was causing the head to seek back and forth across the diskette—stopped operating at 68.4 V.

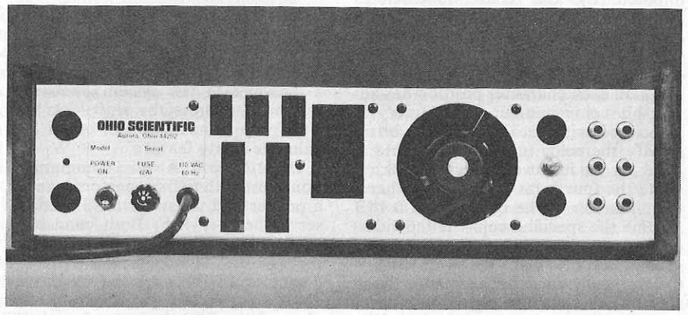
Other System Factors. The C4P-MF is provided with an internal four-card bus structure in which three positions are occupied. In the fourth position, a cable-adapter board blocks some of the space a circuit board might occupy. The bus structure is "nonstandard" and there is no mention in the manuals of plug-in cards that are available for bus use. The rear-panel I/O connector allows connection of three external PIA's through the AC-12 option that can interface up to 48 bits in either input or output operation. Since DMA is not available, interrupts are generated strictly on the CPU board and there is no provision for I/O interrupts. The user is thus restricted to peripherals provided by OSI.

A program was written to force the DOS (and disk head) to seek and load another program located at the opposite side of the diskette. This second program forced the DOS to go back across the diskette and pick up the original program and continue the cycle. Thus, the disk mechanism went back and forth from inner to outer track continuously, making the average half-cycle time an accurate measure of the access time including seek time, rotational latency, and program execution time. Sixty-four full head cycles occured in 50 seconds, producing a 300-ms access time.

To reduce time from a "cold" start and to allow more frequent access to the disk, OSI allows the disk-drive motor to run continuously as long as power is applied. As the mean-time-before-failure (MTBF) for the small dc motors used in 5-inch disk systems is on the order of 1800 hours, the extra operating time is of no special import, though it does count against overall MTBF.

Reset procedure is simple—all that is necessary is to depress the BREAK key. The system then puts up a clear screen and asks for the bootstrap source which can only be the C4P-MF disk. If anything else is specified, the operating system enters its monitor program and allows you to poke around and examine memory.

On start-up, you get the option of entering the monitor, entering DOS, or "unlocking" the BASIC. Before you can enter your BASIC program, you must first clear the BASIC start-up program. Using the disk bootstrap will lose any BASIC program you may have keyed in prior to reverting to the boot. Before going out of BASIC, for any reason, it is prudent to store your data on diskette, since not much will be left after a restart.



Rear panel of C4P with I/O ports.

User Notes. The C4P-MF is clearly designed for use in personal and educational applications. (For engineering/professional use, there's a GT option of the C4P-MF that uses a 6502C microprocessor with ultra-fast static memories.) In its chosen bailiwick, the system offers definite advantages. Its relative simplicity makes learning to use it easy, and its elaborate I/O facilities can save the drudgery (and expense) of engineering interfaces with the outside world.

It's not suggested that the TV monitor be placed atop the mainframe because stray signals radiated from the mainframe can cause a slight "swimming" of the horizontal sweep. A compact setup is best achieved, therefore, by setting the disk drive on the mainframe and the TV monitor a foot or so away. Both the monochrome monitor and the color-TV receiver we used for display purposes were capable of presenting 32-character lines with clarity. On the video monitor, the 64-character lines were superb. We found that the merging of descenders with the character below is only a minor nuisance; it becomes less vexing as one gets used to it.

The BASIC provided with the C4P-MF is excellent and provides all the expected functions. Start-up procedure, which is unusual, seems awkward at first, but soon becomes easy.

Owing to the large number of I/O modes, the C4P-MF encompasses, we were unable to test all of them. Using the software provided, it appears to be relatively easy to control a number of external devices. Since the system also includes a real-time clock, it is possible to activate or deactivate controlled devices at preset times.

With the excellent OSI disk-based software available—including an Information Management System, Word Processor, and a library of program development tools—and with its color graphics, animation capabilities, audio output, joystick controls and a number of personal programs, the C4P-MF is a good buy. While it is true that someone who becomes seriously involved in computers might eventually outgrow it, this computer offers easy entry to the field and lots of room for exploration. ◇

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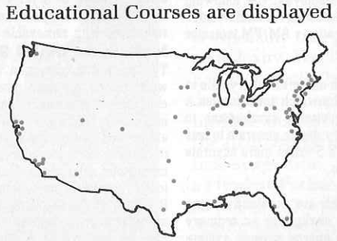

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