# The POLY 88 Microcomputer System

From his dawn, man has been a tool builder and user: tools have multiplied his strengths and senses. Now the computer arrives as a tool to multiply the powers of the mind and the POLY 88 arrives as the first computer system to be integrated into a personal tool. The POLY 88 system offers, on a personal level, the simplicity, flexibility, power and quality present in the finest of tools. This microcomputer represents the first complete inexpensive personal computer system. With a video display for lightning-fast computer output, and a standard cassette recorder for low-cost program storage, you can do your own home accounting, graphics, scientific simulations, advanced games, or any other information processing application. Designed for easy use by newcomers and computer experts alike, the POLY 88 is as versatile as you, the user, are creative. Quality tools are an integral part of man's interaction with his world. This is such a tool. If you're thinking about expanding your personal capabilities, think about a POLY 88.

POLYMORPHIC SYSTEMS
POLY-88

CONDENSER MICROPHONE

ON

201-176

201-173
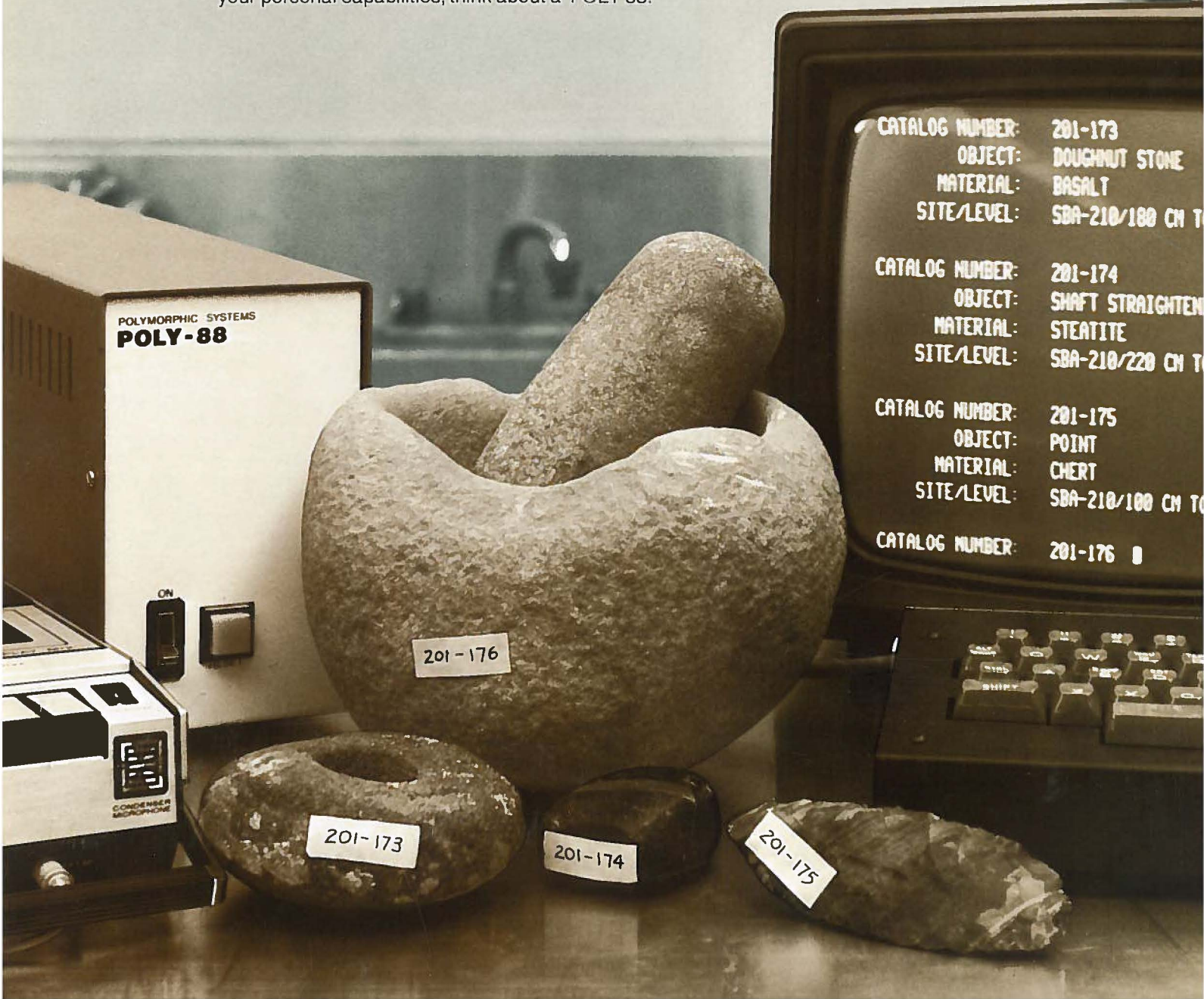
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CATALOG NUMBER:   201-173
       OBJECT:    DOUGHNUT STONE
     MATERIAL:    BASALT
   SITE/LEVEL:    SBA-210/180 CM T

CATALOG NUMBER:   201-174
       OBJECT:    SHAFT STRAIGHTEN
     MATERIAL:    STEATITE
   SITE/LEVEL:    SBA-210/220 CM T

CATALOG NUMBER:   201-175
       OBJECT:    POINT
     MATERIAL:    CHERT
   SITE/LEVEL:    SBA-210/100 CM T

CATALOG NUMBER:   201-176
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The POLY 88 is as versatile a tool as has ever existed. How would you start? Unpack the POLY 88 from a small box or suitcase. Plug the keyboard, video monitor, and cassette deck into the POLY 88 and turn them on. Now you have a decision to make. Should you load a home financing tape, a programmed learning tape, a graph plotting routine, a scientific simulation, or a favorite game? Place your chosen tape in the recorder and tell the computer to read it by typing a simple command. In a few moments the system is ready to use — the tool's application has been defined. To redefine the application, simply load another tape.

To develop your own application for the POLY 88, you will want to write your own programs. If you are new to programming, then plan to spend an evening with the computer to learn a language called BASIC, which is remarkably similar to English. BASIC allows you to write your own home financing programs, appointment calendar/billing programs, simulations, and games.

This versatility is possible because of the unique POLY 88 hardware. The POLY 88 represents an integration of the latest in microcomputer technology with the lowest-cost mass-produced peripherals available — a video monitor and a cassette tape deck. The interfacing electronics to these peripherals are built-in to the POLY 88 in such a way that a program written on any POLY 88 will run on any other POLY 88 without modification. Thus every POLY 88 owner can exchange applications with any other owner, and the software library is constantly expanding.


Software is the collection of computer programs that transform a computer from just hardware into a useful problem solving tool. A powerful and fundamental form of software for any system is a high level language which allows the description and solution of problems in a form that is easy for the operator, rather than in the form actually processed by the hardware.

In the POLY 88 System, the primary high level language is the popular BASIC, available in several versions of differing size and capability. The full verson of BASIC for the POLY 88 System requires 11K of memory, and offers capabilities such as strings, formatted output, multidimensioned arrays, and scientific functions. This BASIC also contains features for the direct use of the POLY 88 System such as access to the real-time clock, point-plotting and graphics using the video display, and the ability to load and save programs as named files on tape. A subset of this BASIC is available which works in only 8K bytes of memory: all programs written for this subset will run without change on the full sized BASIC.
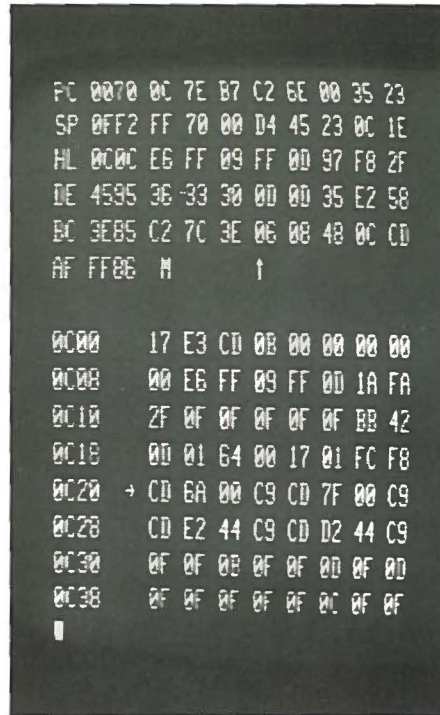

Firmware is special software contained in a permanent memory device and so is immediately usable when the computer is powered-up. The POLY 88 firmware monitor contains the tape input routines allowing programs to be loaded with a simple command from the keyboard. In addition, it contains "front panel" and "single step" features, which allow the user to monitor and debug programs at a glance. All the CPU register contents plus the instructions, stack, and data are displayed in convenient hexadecimal format while the program is single stepped with a simple keyboard command. Since the same firmware is present in every POLY 88 System, all programs and users have this software foundation with which to work.
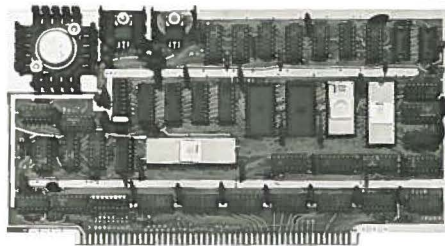

The Central Processor is the heart of the POLY 88 System, but that heart consists of far more than just the 8080A processor chip itself. The POLY 88 processor board contains the firmware. Read-write memory is also included on the processor board for system use, as is a clock for use by programs such as BASIC. An important part of the processor is the communications interface and the interrupt system. Where other machines require separate boards for these functions, the integration of technology in the POLY 88 System includes these with the processor so that these vital functions are present in the same fashion in every POLY 88.

It's rugged chassis is the foundation of the POLY 88 System. Thanks to the firmware monitor the front panel consists of but two switches — one for power, the other for resetting the system. The rear panel has connectors for the cables to the keyboard, video monitor, cassette unit, and other accessories. Inside the chassis is the backplane and power supply. All the components for the power supply are mounted on the backplane board which is conservatively rated at 6A for any five boards that you may wish to plug into the S100 industry standard bus. Optional edge connectors allow more than one POLY 88 chassis to be plugged together for expansion, with each set of five slots having its own power supply.
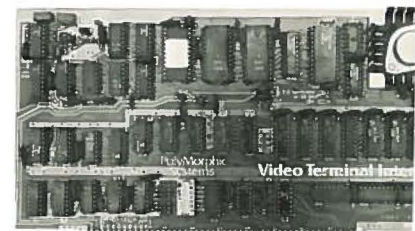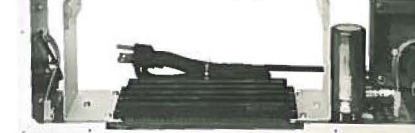
Video Terminal Interface. The versatility of the video terminal increases the value of the POLY 88 as a tool by enhancing the communication between the system and the user. The user supplies information through the keyboard interface on the video board for processing by the system, and the system displays the resulting data on the monitor screen in character or graphic form. The video interface provides a window into the computer system, and allows the user to display rapidly changing information in the form of upper and lower case characters, special symbols and graphics.

The Cassette Interface mini-card is the basis for information exchange between POLY 88 systems. By using the communications functions on the processor board the work of interfacing to a cassette recorder can be accomplished on one small board. The cassette interface deals with information in one of two switch-selectable modes. For program interchange, the well known BYTE standard format may be used, and when higher speeds are desired, the PolyPhase format allows you to load the entire 11K BASIC system in under two minutes.
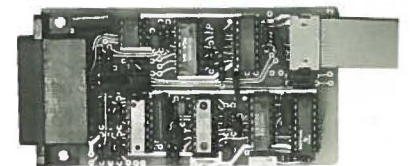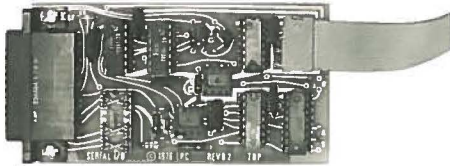
The Printer Interface mini-card allows a wide range of other peripherals to be readily attached to your POLY 88 System, ranging from slow speed hard copy terminals to high speed display terminals.

The POLY 88 electronics are compatible with the S100 industry standard. This means that extra memory, interfaces and peripherals made by PolyMorphic Systems,as well as a dozen different manufacturers, will plug directly into the connectors in the POLY 88 and operate without modification. S100 circuit cards manufactured by PolyMorphic Systems include an 8K RAM memory board, an analog interface board, and a versatile prototyping board in addition to the processor and video interface cards contained in every POLY 88.

The POLY 88 is available as a complete system including memory and all necessary peripherals. It is also available less 8K RAM, video monitor, keyboard, and cassette tape deck. If you intend to provide your own peripherals, we recommend Superscope C102, C103, or C104 tape decks for 2400 baud recording, although almost any reasonable tape deck will perform satisfactorily with the 300 baud BYTE standard. Any video monitor can be used as a display, although a standard TV receiver can usually be modified to work. A modification kit for the Hitachi P-04 or P-05 TV receivers is available from PolyMorphic Systems. Keyboards are standard ASCII 7, with positive logic and control characters.
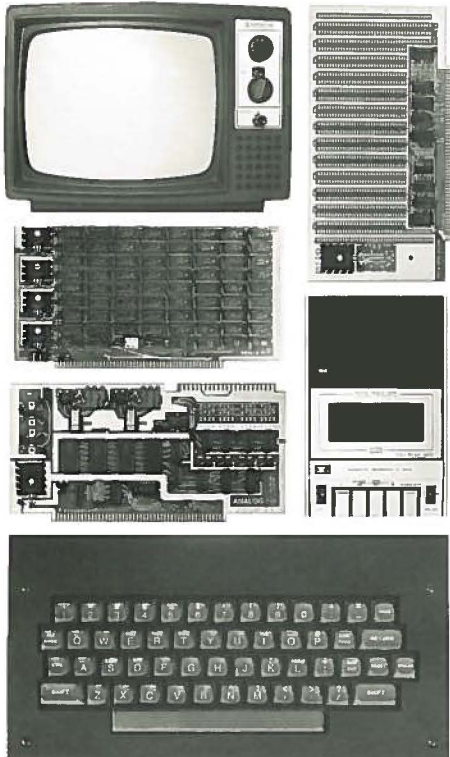
SPECIFICATIONS

Chassis

Power Supplies: +9V at 6A, +18 at 0.75, –18 at –.25A (unregulated) per chassis.
Number of cards: 5
Compatibility: Accepts POLY 88/IMSAI/Altair cards.
Bus Connector Type: Power switch, reset button, halt indicator and power indicator.
Cabinet Dimensions: 4¼" w X 6¾" h X 17" d.
Expandability: Up to 4 chassis may be plugged together.

Processor Card

Processor Type: 8080A
Clock: Crystal controlled 1.853MHz.
Number of Instructions: 78 with 244 variations.
CPU Registers: 10
Addressing Modes: Direct, immediate, register, register indirect.
Addressing Range: 65, 536 bytes of memory and 256 ports.
Interrupts: 8 level vectored.
Real Time Clock: 50/60 Hz (reference to line frequency).
Bus Loading: Outputs drive 30 TTL loads, inputs are 1 TTL load or less
Power Requirements: +8 to 10V at 1.2 amps max., +16 to 20V at 200 mA. Max., –16 to 20V at 140 mA. max. (inc. 3 2708 EPROM).
RAM: 512 bytes 500 nesc. access time.
ROM: Sockets provided for 3K bytes of EPROM or (2708 type) ROM.
Serial I/O Port (option)
Baud Rate: Software controlled 12.5 to 9600 baud (asynchronous) 800 to 57,600 baud (synchronous).
Data Format: 5, 6, 7, or 8 bits with or without parity.
Ports: Can handle up to 2 minicards.
Power Requirements: +8 to 10V at 150 ma, –16 to 20V at 35 ma.

Video Terminal Interface

Character Font: 7 X 9 matrix alphanumeric and 6 element graphic characters.
Character Set: 96 character ASCII plus 32 special characters.
Number of Characters: 512 (1024 optional), 32 (64) characters per line with 16 lines.
Graphic Resolution: 64 (128) horizontal by 48 vertical.
Video Output: Composite video negative sync.
Required Video Bandwidth: 2.5 MHz for 32 charcters, 5.5 MHz for 64 characters.
Input Port: 8-bits plus positive or negative strobe.
Power Requirements: +8 to 10V at 1.25A typ., +16 to 20V at 30 ma max. –16 to 20V at 20 ma max., not including keyboard requirements.

Byte/PolyPhase Cassette Interface

Baud Rate: 300, 600 (Byte); 1200, 2400 (Polyphase).
Connector (to recorder): Standard 25 pin "D" type female Mating connector type=DB-25p or equivalent.
Connector type (to CPU): 14 wire ribbon cable with DIP plug termination.
Power Requirements: +5 ±0.25 VDC at 150 ma max., –5 ±0.15 VDC at 20 ma max.
Input: Approximately 2Vp-p into 15
Motor Controls: (2) will switch up to 200 mA at up to 30V (negative ground).

8K RAM

Storage Capacity: 8192 X 8 bits
Memory Type: 91L02 or equivalent.
Access Time: 500 ns. max.
Address Decoding: Switch selectable in 8K increments.
Memory disable: Controlled by bus pin 67 (PHANTOM).
Power Requirements: +8 to +10 at 2.6A max. +2.2V at 1.5A max. (standby).

Poly I/O Ideaboard

I/O Addressing: Blocks of four addresses.
Power Requirement (excluding user added components): +8 to 10V at 370 mA. max.

Specifications subject to change without notice.

SPECIFICATIONS

Firmware Monitor

Size: 1K bytes in 2708 type read-only memory ROM or compatible mask programmed ROM.
Operation: Fits in zero-addressed CPU ROM socket. Runs on system power-up or front panel reset.
Functions: Tape loader for Byte standard or Polyphase encoded Polyformat absolute binary cassette files. Front panel simulator program produces register and memory display on system video display. Commands allow register, memory modification, program interrupt and single step or return to interrupted program.
Utilities: Routines for teletype simulated I/O on the memory mapped video display, character fetching from system keyboard, hexadecimal conversions, real time clock.
Features: "Wormholes" allow reassignment of I/O devices independent of program I/O handling. Video driver recognizes TAB, FORMFEED, BACKSPACE, LINE ERASE, VERTICAL TAB and CARRIAGE RETURN. Address of video display is reassignable. Interrupts handled through a vector table which allows re-assignment of service routine addresses. Real time clock has 2 year delay capability with automatic execution of preset task on timeout.

PolyMorphic Systems 11K BASIC

Size: 11K bytes.
Scientific Functions: Sine, cosine, log, exponential, square root, random number, x to the y power.
Input type-ahead
Cassette Save, Load, and Verify of Named Programs
Multi-line Functions
Point-Plotting on Video Display
Real-Time Clock
String Manipulation and String Functions
Formatted Output
Memory Load and Store
8080 Input and Output
Multiple Statements Per Line
Renumber
If Then Else
Array Dimensions limited by Memory
Single Character Input

Commands: RUN, LIST, SCR, CLEAR, REN, CONT, SAVE, LOAD, VERIFY.

Statements: LET, IF, THEN, ELSE, FOR, NEXT, GOTO, ON, EXIT, STOP, END, REM, READ, DATA, RESTORE, INPUT, GOSUB, RETURN, PRINT, OUT, POKE, PLOT.

Built in Functions: FREE, ABS, SGN, INT, LEN, CHR$, VAL, STR$, ASC, SIN, COS, RND, LOG, TIME, EXP, CALL, SQRT, PEEK, INP

Systems Available. The POLY 88 is available in either kit or assembled form. It is suggested that kits be attempted only be persons familiar with digital circuitry. The following are the systems available.
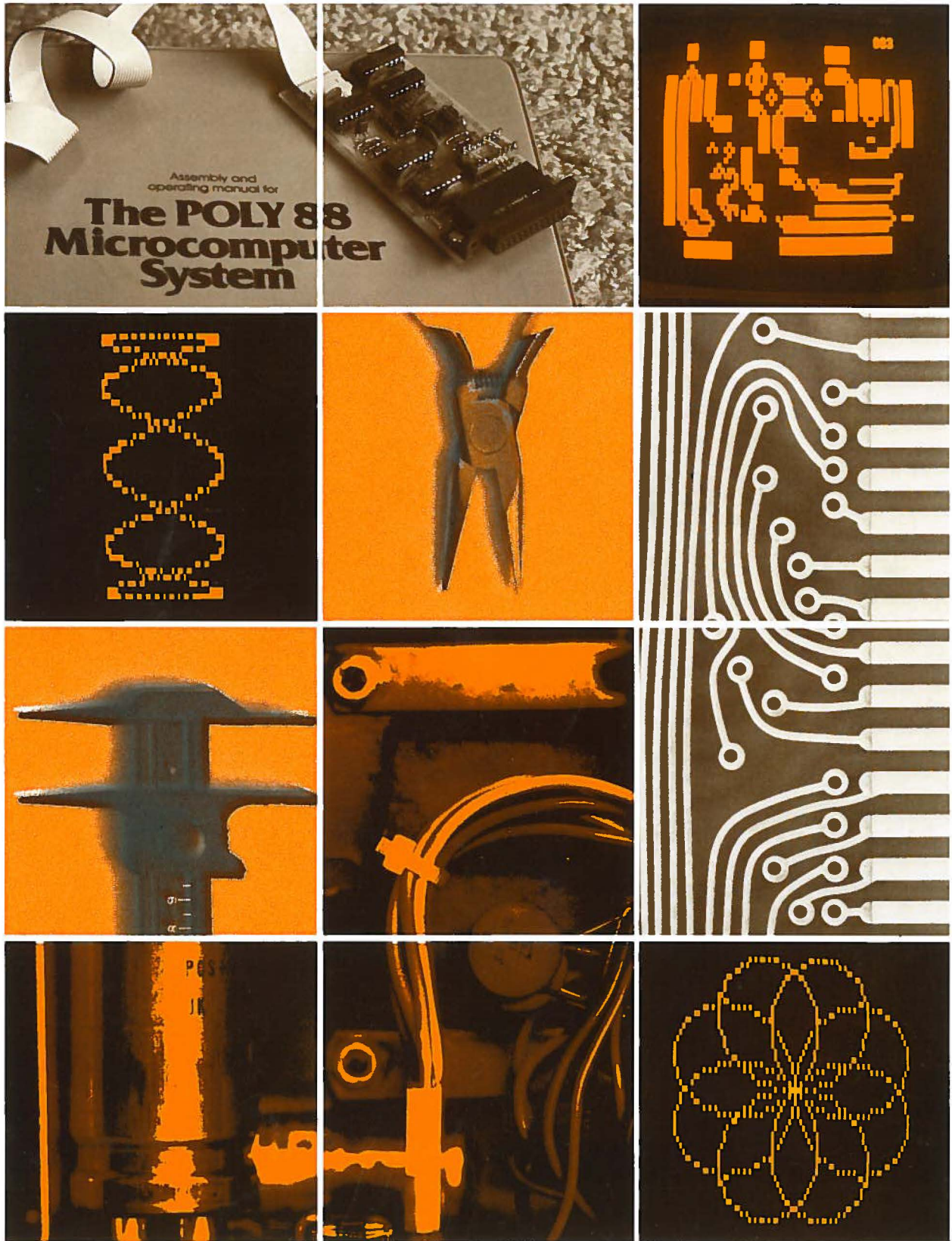
System 16: Ready for programming within ten minutes of delivery. The System consists of the POLY 88 central processor board, video circuit card, cassette interface, 16K of RAM, cabinet, backplane, power supply, fan, keyboard, TV monitor, and cassette recorder. 11K BASIC and Assembler are included.

System 12: The core of the POLY 88...giving you full compatibility with the POLY 88 software library. System 12 consists of the central processor card, video circuit card, cassette interface, cabinet, backplane, power supply, fan, keyboard, 11K BASIC and Assembler. Requires S-100 memory, TV monitor, and cassette recorder for operation.

System 6: A System 16 in kit form, less the TV monitor and cassette recorder.

System 2: A System 12 in kit form, less the keyboard and fan.

System 0: The circuit cards an S-100 mainframe owner needs to be compatible with the POLY 88 software library. System 0 consists of the central processor card with monitor ROM, the video circuit card, and cassette interface, all in kit form.

Assembly and operating manual for
The POLY 88 Microcomputer System