

MACSYM II

A Complete Measurement And Control SYsteM

Sophisticated Hardware that is Easy to Use

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MACSYM II* is a complete stand-alone system designed for measurement and control applications. It brings together a high-speed 16-bit processor, a console terminal with interactive display and full ASCII keyboard, mass storage, a family of analog and digital input/output cards, and powerful software employing a version of the high level BASIC programming language.

Designed for applications involving signal conditioning, data acquisition, storage, computation, manipulation, and display, MACSYM II can deal with analog and digital inputs and outputs in multi-task modes, programmed in BASIC by users who need not be computer experts. Typical inputs might include thermocouples, strain gages, RTD's, switch closures; typical outputs might include 4-20mA control signals, switch drives, or ASCII data.

MACSYM II was human-engineered for laboratory experimenters, control-system designers, and other engineers, scientists, and technicians, whose principal interest is in applying computer intelligence to obtain desired system results, with a simple, cost-effective data-handling system designed to be as transparent as possible. MACSYM's architecture and packaging, software and documentation are specifically designed to minimize the time, effort, and experience required for system configuration, hookup, and operation in the user's real-world environment. MACSYM II programming requires neither prior software experience nor separate development systems. The unique time-saving aspects of MACSYM are described in the pages that follow.

While MACSYM II provides all the power and function traditionally associated with minicomputers in its class, it costs much less. A standard MACSYM II, ready for operation, packaged as a single compact desktop unit (rack-mountable), includes the 16-bit processor, an analog and digital I/O subsystem, real-time multitask BASIC, 64K bytes of memory, cartridge tape drive, full ASCII keyboard (upper case), operator control panel and CRT, and full documentation and system support. Its list price is only \$8,990.

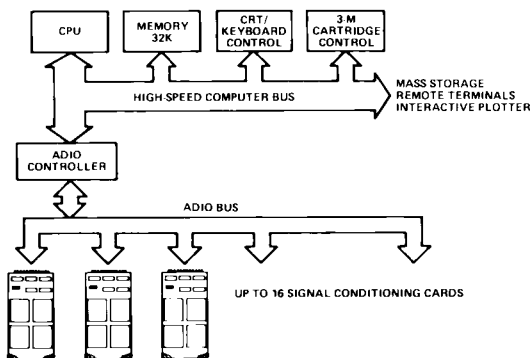


Figure 1. Block diagram of MACSYM, showing the key role of the dual bus system and ADIO Controller.



MACSYM II SYSTEM ORGANIZATION

Figure 1 is a simplified block diagram of MACSYM II, depicting the organization of the major components comprising the system. The *Central-Processing Unit* (CPU), described more fully on page 5, is a 16-bit high-performance unit built from micro-programmable Schottky 4-bit-slice elements and capable of addressing 64K bytes of memory. Special features of the CPU include byte-manipulation instructions and floating-point mathematics.

A key element of MACSYM II is the dual bus system. The processor communicates with memory and computer-type per-

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ipherals via the conventional computer bus structure. However, communication with the *analog and digital I/O cards* (see page 7) is established by way of the *ADIO Controller* (page 6), an intelligent interface which provides a number of shared functions (such as a/d conversion), minimizing cost of the individual cards, and isolating the input/output bus (ADIO bus) from the noisy high-speed processor bus, permitting improved performance to be obtained with low-level analog input signals. The ADIO Controller deals with each card on the basis of its own identity; this makes it possible to utilize any assortment of cards, plugged into any permutation of the 16 sockets (Figure 2).

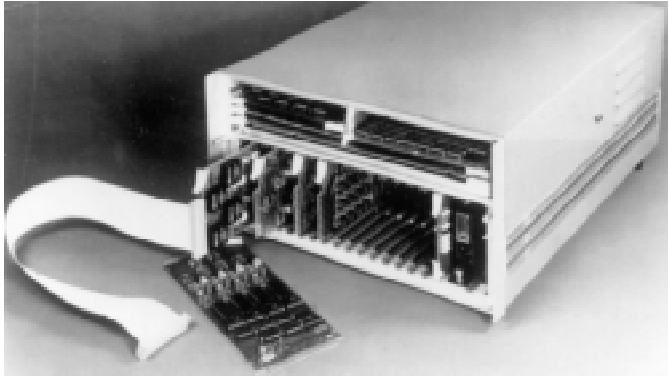


Figure 2. Any signal-conditioning card slides into any one of MACSYM's backplane slots. The cards permit direct sensor hookup to MACSYM II at low cost for a wide variety of I/O functions.

MACSYM II, as noted earlier, is an interactive stand-alone unit. This is made possible by the integral processor-controlled full-ASCII keyboard and the five-inch CRT display. The display format is keyboard-selectable as either 16 lines of 32 characters, or 16 lines of 64 characters.

MACSYM's fully buffered read/write memory is organized as 32K 16-bit words, utilizing mature, 4K dynamic MOS RAM technology for low power dissipation. There is a nickel-cadmium battery for memory backup in the event of a power failure. In addition, an automatic startup protocol provides for orderly initialization after a power failure. Mass storage of both data and program is provided by an integral data-cartridge system, which has 100K byte capacity, uses a microprogrammed controller, and requires no extra hardware. The mass-storage system performs data encoding and decoding, and it controls tape position and movement.

Some of the other salient features of MACSYM include: a real-time clock, serial communication ports, and an IEEE-488 communications interface. In addition, MACSYM has been designed to interface with a number of peripherals, which can be provided by Analog Devices. Among these peripherals are: mass-storage systems (single or dual floppy disk or 9-track magnetic tape), remote terminals, and an interactive graphics plotter.

Capabilities of the signal-conditioning card family include:

- Low-level analog in/analog out
- Direct sensor interfaces: thermocouple, strain gage, RTD, etc.
- Digital input/output
- Isolation
- Special functions

As many as 16 assorted cards may be plugged into MACSYM

II's card cage; their number may be extended to 120 cards, via extension chassis. The user's external wiring can be brought to edge connectors and plugged directly into the cards. A useful alternative option is a 50-terminal screw-termination board for making direct connections to sensor wires. For larger systems, a rack-mounted screw-termination panel provides for the mounting of eight screw-termination boards (Figure 3).

MACSYM II SOFTWARE

Like MACSYM's hardware, the software has also been designed specifically for measurement and control *applications* (see page 12). An outgrowth of easy-to-use, problem-oriented BASIC, MACBASIC is a powerful tool with some interesting properties (see page 10):

1. *Integral I/O Statements.* All measurement-and-control inputs and outputs are treated as simple variables within statements; ranging and formatting are performed automatically. For example,

$$X = \text{SQR}(\text{AIN}(7,5) * 100)$$

means that the voltage at Channel 5 of the Multiplexer Card plugged into Slot 7 is to be multiplied by 100, and the square root of the resulting number is to be computed. If AIN(7,5) is 5.42V, the result in response to the command,

```
PRINT X
23.28
```

2. *Multitasking.* Multitasking in BASIC allows the user to handle simultaneous asynchronous events or operations in a simple, orderly manner. Tasks may be activated either unconditionally or on the arrival of a time of day, an external event, or the conclusion of a periodic interval. While in multitasking, the console terminal is "live"; the user can debug or exercise full control over his program in real time. To support multitasking, complete resource-allocation and intertask communication facilities are provided.

3. *Full computational repertoire.* All the computation facilities of BASIC, plus various special computations, data-storage, and data-presentation functions are available.

4. *Interactive graphics.* A full interactive graphics package supporting the interactive Tektronix 4662 Digital Plotter is available; it uses simple BASIC statements.

The BASIC Manual starts with material written specifically for the user with little or no programming experience; it enables him to manipulate real-world application data immediately. Commands and statements are introduced in logical progression; within a few pages, the user will be able to write programs in BASIC. At the end of the introductory session, the user's firm grasp of BASIC programming will have fully prepared him to comprehend and deal with the transition to MACBASIC.

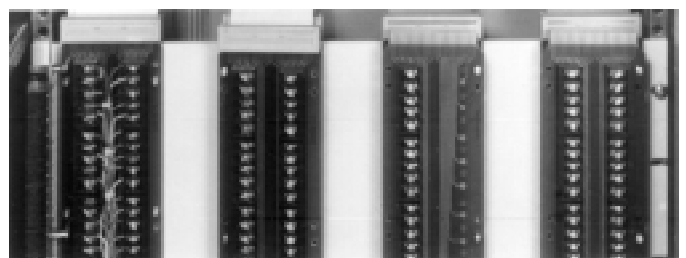


Figure 3. Screw-termination boards make connection of external I/O devices easy. MACSYM is available for table or rack mounting.