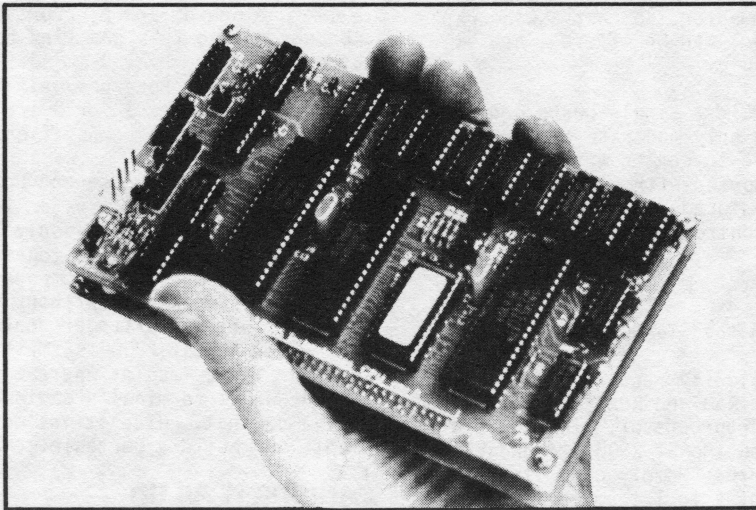


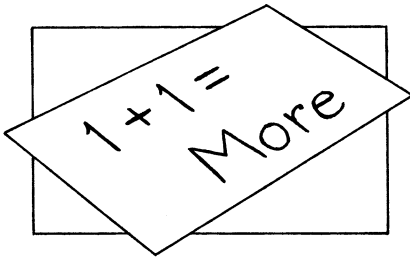


**Introduces the  
ST-2900 System**



**The 6809 Computer  
with a  
Split Personality**

## The "System"



The ST-2900 "System" was developed by Sardis Technologies to meet three main goals:

- 1) use advanced technology to create a very compact 6809 based computer, but ...
- 2) offer more flexibility than the typical single board computer, so that a wide range of configurations can be offered, and ...
- 3) make it affordable.

But what could a single board controller containing only moderate amounts of memory and I/O have in common with a full blown business computer with 64K RAM, several megabytes of disk storage, a printer, and more? Or with a controller needing specialized, custom I/O?

### Flexible

That's when the ST-2900's two board concept was born.

Systems typically require various amounts of memory (RAM and ROM) and serial I/O to support the microprocessor. These are all grouped together on the ST-2900's foundation board, the CPU board. Memory capacity can vary by a factor of 4 to 1 from maximum to minimum. If no additional I/O is required, this board can run all by itself for minimum size and cost. But the 60 pin expansion connector lets it do more.

Additional I/O is where needs vary greatly from system to system. Motherboard systems (S-100, SS-50, etc.) can meet these needs, but at a price -- high cost and large size. ST-2900 gives you a choice of which I/O board to plug into the main board (CPU), but the two boards together are still small enough to fit in your hand! And are easy on your wallet.

### Economical?

You bet -- less than (\$US) \$299 \* for a 6809 microprocessor with 64K RAM, 2 serial ports, 2 parallel ports, and double density floppy disk controller. With some other systems the motherboard alone costs as much, and what can a motherboard do by itself!

\* (estimated cost of buying and populating the CPU and FDC board set, based partly on mail-order prices found in the Feb. '84 issue of BYTE magazine.)

### Compact

How small is each board? Look for the life-sized cardboard template enclosed with this brochure. Remember that you're holding the equivalence of a 2 port serial I/O board, a 64K RAM board, and a processor board, all condensed into this one tiny board. Eurocard size, or 100 mm by 160 mm (3.9"x 6.3") small, to be precise. Note how well the boards would fit beside the new 3" or 3 1/2" floppy drives. Unlike most of the competitions' larger single board computers.

Even when the second board is added, "sandwich" style, the system is not one millimeter longer or wider -- only "thicker". And by connecting the boards together back-to-back you get a bonus -- all components on both boards are accessible without unplugging the boards. Without extender boards.

If the ST-2900 is small enough to hold in your hand, imagine where else it could fit. Inside a CRT terminal's cabinet, or a disk drive cabinet. Hide it inside test equipment. Or build a portable computer around it.

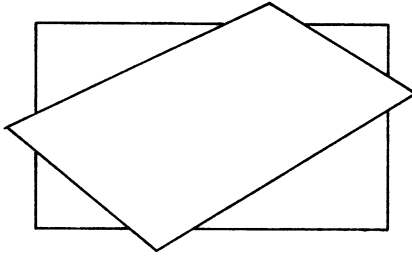
### Adding It All Up

The versatile ST-2900 system from Sardis Technologies -- compact one and two board configurations to meet your various needs. At an affordable price.

**Motherboard system too bulky and expensive?**

**Single board computer not flexible enough?**

# CPU Board



## Introduction

The ST-2900 CPU board from Sardis Technologies is a lot more than just a powerful, yet very compact standalone single board computer. Designed around Motorola's 3rd generation microprocessor, the 6809E, it also forms the foundation and main building block of the whole ST-2900 system.

The capability to run all by itself is provided by supporting the microprocessor with onboard RAM, EPROM, serial and parallel ports, and a counter/timer. In this configuration it can be used as a control system, a buffer/spooler for a serial printer, or with the addition of a CRT terminal, as an educational trainer.

But that's only half the story. Plug an expansion board (such as our FDC) into the 60 pin connector and it becomes the equal of other much larger systems.

## Features / Specifications

- 1 MHz 6809E microprocessor
- 16K or 64K dynamic RAM (single +5v supply only) with transparent refresh runs cool and draws little power. No adjustments or timing problems, as a crystal controlled digital circuit generates precise timing.
- 2K-8K EPROM -- one JEDEC standard 28 pin socket holds a 2716, 2732, or 2764. A 2716 with the ST-MON monitor program is included even with the bare board.
- 2 asynchronous serial RS-232 ports each with RTS, CTS; independently software selectable for 50-38400 bps, 5-8 data bits, parity, stop bits, interrupts, etc. The signals are brought out to two 14 pin ribbon cable connectors.
- one 16 bit multi-mode counter/timer
- 6 bit parallel output port (4 bits used by the FDC board)

- 5 bit parallel input port
- 9 clock signals ranging from 15.625 KHz to 4 MHz
- connector for manual reset switch
- 60 pin connector for one expansion board (FDC, etc.)
- tight address decoding and the ability to switch the EPROM in and out of the memory map (via software) gives you a full and contiguous 64K RAM minus only the high end 256 bytes for I/O, etc. Some of the competition waste almost 8K bytes!
- power requirements +5 @ 700 mA  
                                  +12 @ 20 mA
- 100 mm x 160 mm (3.9"x6.3") board size
- soldermask both sides, silkscreened component overlay for ease of assembly

## Brains . . .

The Motorola 6809E microprocessor gives you much of the power of 16 bit processors, but retains the economy and simplicity an 8 bit unit affords.

- four 16 bit registers which can be used as index registers and stack pointers; the two 8 bit accumulators can be concatenated into another 16 bit register. Many 16 bit operations.
- 8 bit by 8 bit multiply
- powerful addressing modes including auto increment/decrement by 1 or 2, and program counter relative. Several modes have indirection. These modes make writing position independent, re-entrant (shareable) routines easier.
- consistent instruction set makes assembly language programming easier.

## . . . and Sheer Talent

Nimble-fingered. That's only one of many words you could use to describe the Signetics 2681 DUART (DUAl Asynchronous Receiver/Transmitter) that incorporates 2 serial ports, 4 baud rate generators, crystal oscillator circuitry, 2 parallel ports, and a counter/ timer -- all in one 40 pin package! The following list of features will give you an idea of why we chose it over the 6850 ACIA used in many other 6809 systems:

- 5, 6, 7 or 8 data bits per character (so you can send Baudot)
- 1, 1 1/2, or 2 stop bits in 1/16 bit increments (for "bit shaving")
- receiver and transmitter baud rates can be independent of each other

- software programmable baud rates from 50 to 38,400 bps, or feed an external 1x's or 16x's clock, or use the counter/timer to generate non-standard rates. Maximum data rate is 1,000,000 bps with a 1x's clock
- quadruply buffered receivers to minimize data loss or reduce interrupt frequency
- each channel can be set to normal, automatic echo, local loopback, or remote loopback modes
- automatic wake up mode for use in multi-drop applications
- multifunction 8 bit output port for RS-232 control signals such as RTS, or general purpose use (the FDC board uses 4 lines)
- multifunction 7 bit input port for RS-232 control signals such as CTS, external clocks or general purpose use. Change-of-state detectors on four of the lines.
- 8 different status signals can be individually disabled/enabled to cause interrupts
- multi-function 16 bit counter/timer

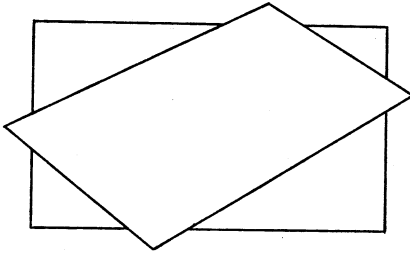
## **ST-MON Monitor**

The ST-MON monitor program is included at no extra charge with the purchase of the CPU board. It is used at powerup to initialize the system and allow the CPU board to communicate with a terminal. It is also used to load the operating system from disk (if attached). Self diagnostics are performed at powerup. ST-MON is supplied in a 2716 EPROM with an accompanying user's/programmer's manual and has the following commands:

- memory examine/change byte by byte
- display blocks of memory (in hex and ASCII) at 16 bytes per line
- memory test
- fill block of memory
- move block of memory
- search for byte
- jump to user program
- load Motorola MIKBUG S1/S9 format (from either serial port). This lets you develop custom software on another machine and download it to the ST-2900 CPU board.
- boot up the FLEX operating system

Source code (modular and thoroughly commented) is available separately on disk at a reasonable cost for those who need to customize ST-MON.

## FDC Board



### Introduction

The ST-2900 FDC board contains a versatile double-density floppy disk controller and two 8 bit parallel ports. When used together with our 64K CPU board it provides the basis for a powerful computer for business or home.

### Floppy Disk Controller

High capacity:

- up to 3 Megabytes (formatted) total storage on-line -- equivalent to approximately 1500 double-spaced typewritten pages
- up to four disk drives supported

Flexible:

- single or double density operation (software selectable)
- single or double sided drives supported
- 3", 3 1/2", 5 1/4" drives supported
- 35, 40 or 80 track drives supported
- uses Western Digital 1793 floppy disk controller chip, or equivalent
- inactivity time-out circuit to prolong drive and media life -- adjustable duration

Hassle-free:

- uses SMC 9229T floppy disk controller support chip
- digital data separator requires no adjustments, no fancy test equipment. It incorporates separate short- and long-term timing correctors to assure accurate clock separation.
- digital write precompensation with 8 selectable values
- read data line has Schmitt trigger input buffer for reduced susceptibility to noise
- meets the data hold-time requirements of the WD 1793 chip

## Parallel Ports

Each of the two parallel ports consists of 8 data lines which can be individually programmed to act as inputs or outputs, plus 2 control lines. The signals are brought out to 14 pin ribbon cable connectors.

### More Goodies

The FDC board has a prototyping area large enough to hold a 50 pin ribbon cable connector, one 40 pin IC, one 16 pin IC, and some discrete circuitry.

The 6522 VIA (Versatile Interface Adapter) used to implement the parallel ports has several additional powerful features.

Seven different status signals can be individually disabled or enabled to cause interrupts.

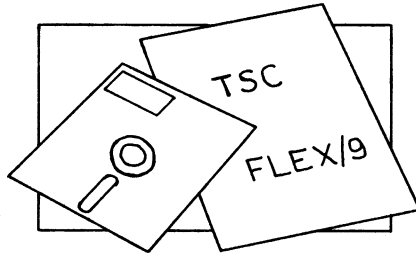
- Two 16 bit multi-mode counter/timers:
- both can operate as an interval timer (approx. 2 usec. - 65 msec.) in one-shot mode. Timer 1 (T1) can also output a pulse of that width.
  - T1 can also operate in a continuous mode to generate interrupts at approx. 2 usec. to 65 msec. intervals, or output a square wave at 8 Hz - 250 KHz
  - T2 can count pulses from an external source

An 8 bit shift register can perform serial input or output data transfers.

### Features / Specifications

- floppy disk controller supports up to four 3" or 3 1/2" or 5 1/4" drives, single or double sided, single or double density, with digital data separator and write precompensation
- two 8 bit parallel ports (unbuffered)
- two 16 bit counter/timers
- one synchronous 8 bit shift register (P -> S, S -> P)
- prototyping area
- 60 pin connector plugs into the ST-2900 CPU board
- power requirements +5 @ 350 mA  
+12 @ 15 mA
- 100 mm by 160 mm (3.9"x6.3") board size
- soldermask both sides, silkscreened component overlay

# FLEX Software



## Introduction

A computer without software is just an expensive paperweight. By choosing to support the FLEX™ operating system for the ST-2900, Sardis Technologies has ensured the availability of a wide range of software.

Note that our current implementation requires a 64K CPU board, an FDC board with two or more 5 1/4" floppy disk drives, and a CRT terminal running at 9600 bps. Other configurations may be supported in the future.

(FLEX is a trademark of Technical Systems Consultants)

## FLEX Operating System

Like CP/M for the 8080 and Z-80 microprocessors, FLEX was not written by a hardware manufacturer as a proprietary operating system, but by an independent software house to be an industry wide standard operating system. It has achieved widespread acceptance in the 6809 community and runs on hardware as diverse as the Radio Shack Colour Computer with one floppy disk drive, to large systems from Southwest Technical Products Corp. and GIMIX, running on hard disks. Dozens of software vendors have produced packages to run under FLEX, ranging from compilers and utilities, to applications packages for business. Some of its features are:

- dynamic filespace allocation
- sequential or random access files
- automatic compression and expansion of spaces in text files for more efficient storage
- defective sectors on a disk are automatically "removed" when disks are formatted
- files stamped with date of creation
- "English" error messages

- automatic drive searching can be invoked to search all ready drives for a given file
- I/O redirection lets you send a listing to the CRT, printer, or disk, or receive key-strokes from the keyboard or disk (nice for automatic demos of software packages).
- built-in printer spooling software lets you print a long document while you use the system to do something else.
- assembly language programs that use disk I/O are easier to write for FLEX than for CP/M
- user startup facility
- automatic execution of a series of batch job steps

- keeps track of number of disk read/write errors (if any), plus optional detailed error logging
  - the so-called "Wilton-Hart fix" is implemented, supported by a hardware timer that is adjustable
- 6) well documented source code of the I/O drivers is available separately on disk
  - 7) documentation includes detailed written instructions on adapting several popular software packages such as Stylograph, SuperSleuth, Screditor III, and DynaCalc to run on the ST-2900. Also included is a list of systems and applications software available for FLEX and the addresses of who supplies it.

## ST-2900 FLEX Conversion Package

The FLEX operating system, as it comes out of the box from TSC (Technical Systems Consultants), can not run on the ST-2900. FLEX first has to be told about the specific I/O requirements of the ST-2900. You don't have to do any of this programming yourself, though, if you purchase the ST-2900 FLEX Conversion package from Sardis Technologies. This package performs the necessary adaptation automatically.

- 1) Use with either TSC's General Version of FLEX, or TSC's FLEX for the SWTPC.
- 2) SYSGEN utility to create new systems disks efficiently
- 3) fast disk FORMAT utility -- lets you format single and double sided, single and double density, 35, 40 or 80 tracks, and either 9 or 10 sectors per track (16 or 18 if double density). Takes only 35 seconds for 40 track single sided.
- 4) other utilities to examine and set disk parameters (stepping rates, etc.), and printer parameters.
- 5) the FLEX I/O drivers (BIOS in CP/M parlance) have been enhanced to allow the following:
  - disk based printer spooling implemented
  - automatic drive searching implemented
  - unlike some other 5 1/4" implementations, trying to access a drive that doesn't exist or has no disk inserted will NOT hang up the ST-2900 system forever (or until reset)
  - automatic recognition of single and double density disks
  - disk drive stepping rates settable individually for each drive

## Applications Software

A large variety of systems and applications software that runs under the FLEX operating system is available from other sources. It includes text editors and formatters, word processors and spelling checkers, sort/merge, electronic spreadsheets, data management systems, debuggers, macro assemblers, compilers or interpreters for BASIC, C, FORTRAN, Pascal, FORTH, and applications packages for accounts receivable, accounts payable, general ledger, inventory control, order entry, specialized packages for specific types of businesses, etc.

# Last But Not Least

## Documentation

Whether you buy our boards bare or partially assembled, the documentation will include:

- complete schematics and parts list
- assembly instructions
- trouble-shooting hints
- theory of operation
- partial reprints of data sheets for the less well-known chips
- bibliography of magazines, books, and data sheets for background information

## Bare Boards vs Assembled

Our boards are currently offered in two forms:

- 1) Bare boards -- printed circuit boards with documentation. It is up to you to purchase the necessary parts and solder them in place. Although our documentation includes assembly instructions, they are aimed at the individual who has built electronic projects before, and has had some experience at soldering computer type P.C. boards. Many of you will find our partially assembled units more suitable than our bare boards.
- 2) Partially assembled boards -- all resistors, capacitors, crystals, IC sockets, connectors, etc. are included, already soldered in place. No additional soldering is necessary. All you need to do is purchase the required integrated circuits (which are NOT included) and plug them into the sockets.

## Custom I/O Made Easy

Do you have special I/O needs that our standard I/O boards don't supply?

Now you don't need to choose between designing a whole new system from scratch, or going the motherboard route. Building your own custom I/O board to plug into the ST-2900 CPU board saves you time and money. Because half the system -- the CPU board with its microprocessor, RAM, EPROM and serial I/O -- is already designed and debugged. And the wealth of signals included in the 60 pin board-to-board connector make it easy. (Note - these signals are unbuffered.)

Besides the usual 8 bits of data and 16 bits of address lines, both 68XX/6502 type R/W and 02/E as well as 8080/Z-80 type RE and WE lines are provided. Four decoded chip select lines simplify your design. Two are intended for I/O chips and have 32 bytes address space each. The other two are read-only, so are only useable for EPROM's -- they occupy 8K and 16K bytes, respectively. Several unused input and output lines from the 2681 DUART are also brought across.

## Looking Ahead

Several products to enhance the versatility and power of the ST-2900 system are being planned for the future. However, no estimated completion dates can be given yet. Some highlights of our "wish list" are:

The OS-9 operating system -- a multi-user, multi-tasking, interrupt driven operating system handling position independent, reentrant (shareable) modules. It is rapidly becoming THE operating system for the 6809 microprocessor.

Specialized I/O boards to plug into the CPU board instead of the FDC board. Several are under consideration. Your suggestions are welcome.

"Personality" adapter mini-boards to convert the parallel ports on the FDC board into special purpose ports such as a buffered Centronics parallel printer port, or even a hard disk port.

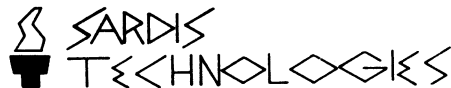
Adapter board to let you have a modem and a serial printer share the second serial port on the CPU board.

A video terminal controller board to match the ST-2900 board size would let you build a very compact, portable computer.

Watch for our ads in "Electronics Today International" (Canadian Edition) or "'68' Micro Journal" magazines for announcements of these and other products.

---

Sardis Technologies reserves the right to change product specifications at any time without notice.

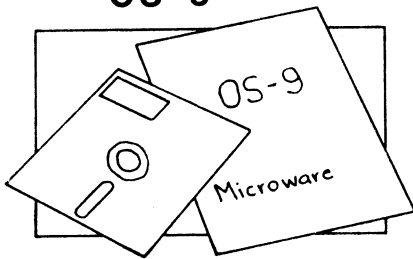


2261 East 11th Ave., Vancouver, B.C., Canada V5N 1Z7

Phone (604) 255-4485



## OS-9



### OS-9 Operating System

OS-9 is a sophisticated multi-user, multi-tasking operating system that was modelled after UNIX, yet is simple and compact enough to be able to run on a 64K floppy disk based system. In the past three years the number of OS-9 users has increased dramatically to an estimated 200,000 making it THE operating system for the 6809 microprocessor. At the same time, Microware's release of OS-9 for the 68000 microprocessor provides a relatively painless upgrade path for those users who will eventually outgrow the 6809.

A unique feature of OS-9 is its "memory module" management system. Memory modules are objects (program or data) that are to be loaded into RAM or are already in ROM. Because they are position independent, several can reside in memory at once. Since they are reentrant, each can be shared by more than one user, reducing overall memory requirements. They can be linked together at run time, which makes writing modular software easier. Actually, the entire operating system itself consists of many memory modules. Other features of OS-9 are:

- UNIX type tree structured directory system
- compact (3K) kernel written in assembly language for speed
- device independent unified I/O structure
- shell supports I/O indirection, pipes, and concurrent execution
- multi-tasking lets you perform tasks (such as printing a long document) in the background, while you continue to use the system for another job
- modular design makes it easy to replace or install new device drivers and system calls
- all memory modules (incl. the operating system itself) are ROM-able. This is useful for ROM-based, diskless controllers
- dynamic filespace allocation
- files stamped with date of creation and time of last update
- OS-9 has become an operating system family

that at one end supports dozens of users, megabytes of memory, and gigabytes of hard disk, and at the other end will run on a dedicated controller with only 4K ROM, 2K RAM, no disk, and no terminal!!

### ST-2900 OS-9 Conversion Package

Sardis Technologies, instead of supplying a pre-configured version of OS-9 for the ST-2900, lets you save over \$130 by offering a conversion package to be used in conjunction with the Radio Shack Colour Computer (CoCo) version of OS-9.

No programming is involved -- you just follow a sequence of simple instructions -- and the whole process only takes a few minutes. The conversion package automatically replaces the CoCo "device drivers" with new ST-2900 drivers. The adaptation takes place on the ST-2900 itself -- no other computer is needed. Don't be fooled by the low price -- you end up with a full-blown version of OS-9 Level I.

- use with the Radio Shack CoCo version of OS-9 -- saves you over \$130 off the list price of OS-9!!
- flexible disk formatting utility formats single and double sided, single and double density, any number of tracks, standard OS-9 or CoCo OS-9 formats
- disk drivers let you read and write CoCo OS-9, MIZAR OS-9/68K, and standard OS-9 disk formats. Disk drive stepping rates are settable individually for each drive. Includes capability to directly read non-OS9 disks with sector lengths of 128, 256, 512, or 1024 bytes, single or double density.
- console driver is interrupt driven and buffered to allow type-ahead
- clock driver keeps time much more accurately than the CoCo's clock

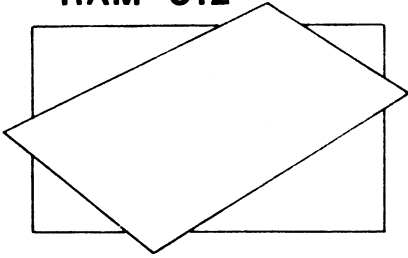
### IBM Compatibility

Now you can read, write, and even format MS-DOS and IBM PC-DOS disks on the ST-2900! Our OS-9 Conversion Package is compatible with D.P. Johnson's PC-XFER utilities (available at extra cost) which let you transfer files between an ST-2900 system and an IBM PC (or other MS-DOS system), in both directions, by swapping disks -- no more messing with slow serial links and communications programs.

(current version only supports MS-DOS disks that are single sided and have a single level directory)

(trademarks: IBM - International Business Machines Inc.; OS-9 - Microware and Motorola; MS-DOS - Microsoft)

## RAM-512



- boards to form a very compact three board "sandwich"
- 106 mm by 160 mm (4.15" x 6.3") board size
- operating range is 512 KHz to 1 MHz
- OS-9 Level II is not supported

### INTRODUCTION

=====

The ST-2900 RAM-512 expansion board contains a half-megabyte (512K bytes) of memory. When used as a high speed virtual disk (RAM-DISK) it greatly improves total system performance.

The huge storage capacity -- 40% more than a double-sided, double-density 40 track 5" disk -- handles large sorts and compiles with room to spare. Compile times for Microware's OS-9 C compiler are dramatically slashed. Under FLEX, the Screditor III text editor loads in under 2 seconds!

Other possible applications include disk caching and printer buffering.

### FEATURES / SPECIFICATIONS

- =====
- 524,288 bytes of dynamic RAM (sixteen 256K x 1 chips)
  - configured as 128 4K pages, any one of which can be selected to occupy a "window" at \$E000-\$EFFF by simply writing the desired page number to the page select latch (\$FFB8 or \$FFBC)
  - two RAM-512 boards can co-exist in one system, for a total of 1 megabyte!
  - fully transparent refresh, using a proprietary dynamic RAM refresh circuit based on the odd/even technique. Guarantees that all memory locations are refreshed well within specs, but by only refreshing every 8th clock cycle, avoids the severe "over refreshing" found on some other designs that unnecessarily increases power consumption.
  - cool running -- typical power consumption is less than 400 mA @ +5v
  - uses a delay line (no one-shots) for reliable and precise timing
  - double-sided printed circuit board, solder-mask both sides, silkscreened component overlay
  - RAM-DISK driver routines and memory diagnostic utility supplied on disk for either FLEX or OS-9. Source code ~~included~~ available.
  - fits between the ST-2900's CPU and FDC

-----

ADDITIONAL ODDS AND ENDS

=====

- \* With a minor modification the CPU board will handle a 27128 or 27256 EPROM. This would allow you to load the entire FLEX or OS-9 operating system plus some utilities and user programs without a floppy disk. If even more EPROM capacity is needed, a simple 5 chip custom expansion board could be built to hold 4 EPROM's plus a 74LS155. When 27512 EPROM's come down in price, this solution would give you a total of almost 1/3 megabytes of EPROM storage!!

# **ST-2900 CPU Board Actual Size**