THE THUNDER 186
SINGLE BOARD COMPUTER

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If you are looking for a powerful yet economical system, consider the Thunder-186 single board computer by Lomas Data Products. The board features the powerful 8-MHz 80186, 256K of Dynamic RAM, two serial ports, and one parallel port. It will control both 8- and 5¼-inch floppy disk drives. The Thunder-186 is available for less than $1000. With it, a full system with two floppy drives and terminal can be built for less than $2000.

PROCESSOR FEATURES

Many of the features of the Thunder-186 are actually functions of the 80186 chip. Foremost, the processor is object code compatible with the 8086/8088, allowing it to run most popular software packages. In addition, the 80186 provides several new instructions, most notably those for block I/O, pushall and popall registers, and some immediate arithmetic.

The real benefit of the 80186 is its inclusion on board of several functions normally requiring peripheral chips. This allows the designer to package more capabilities on a single

S-100 board. In the Thunder-186, some of the extra capabilities are an interrupt controller, two DMA controllers, and three timer/counter functions. One of the DMA controllers is used as the floppy disk controller. Two of the timers are used by the serial ports to set the baud rates, and the other is used as the real-time clock by the supplied CCP/M operating system.

Another significant advantage of the 80186 over the 8086 is its hardware computation of the complex Intel addressing scheme, which increases speed by about 20%.

Unfortunately, the external inputs to the timer/counter circuit are excluded from the board. These were left out probably because, in the principal operating mode, the timers are not available (they are tied to the serial ports and the real-time clock).

SUPPORT FEATURES

The support hardware on the board provides several useful features. Two serial ports are controlled by two 8251A USARTs. One serial port is used by the system as a terminal.
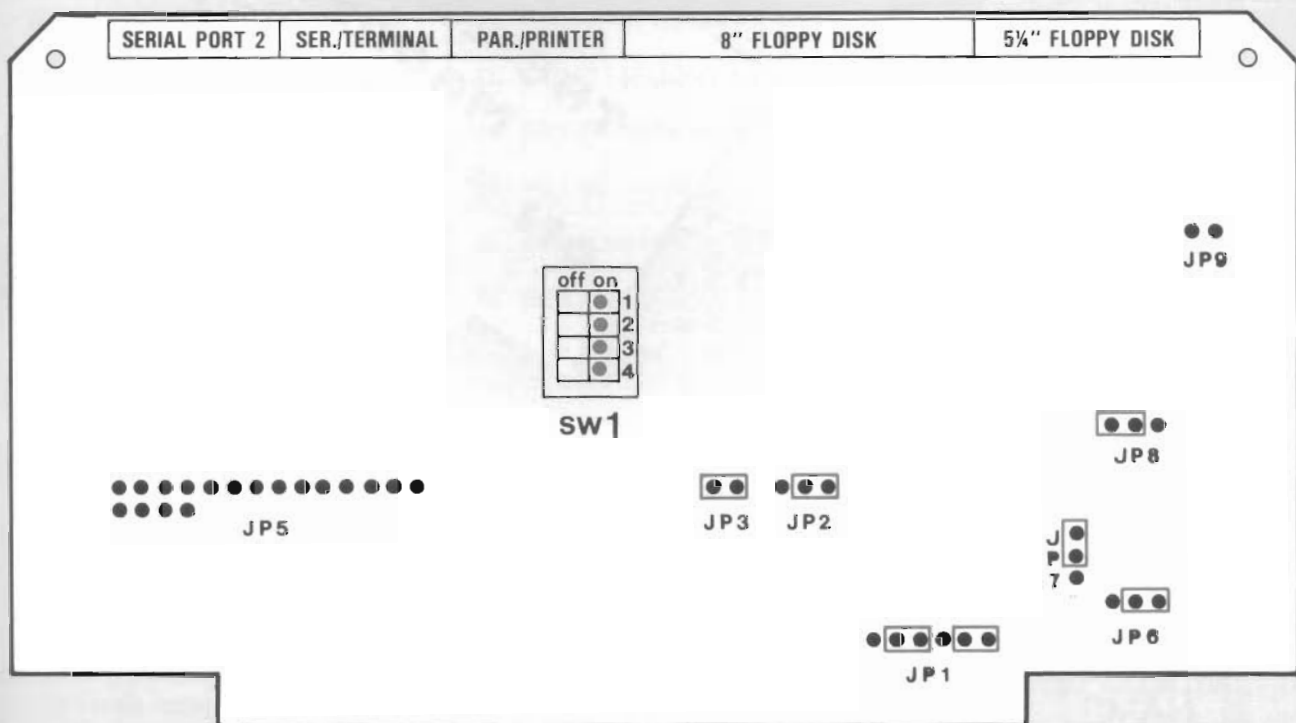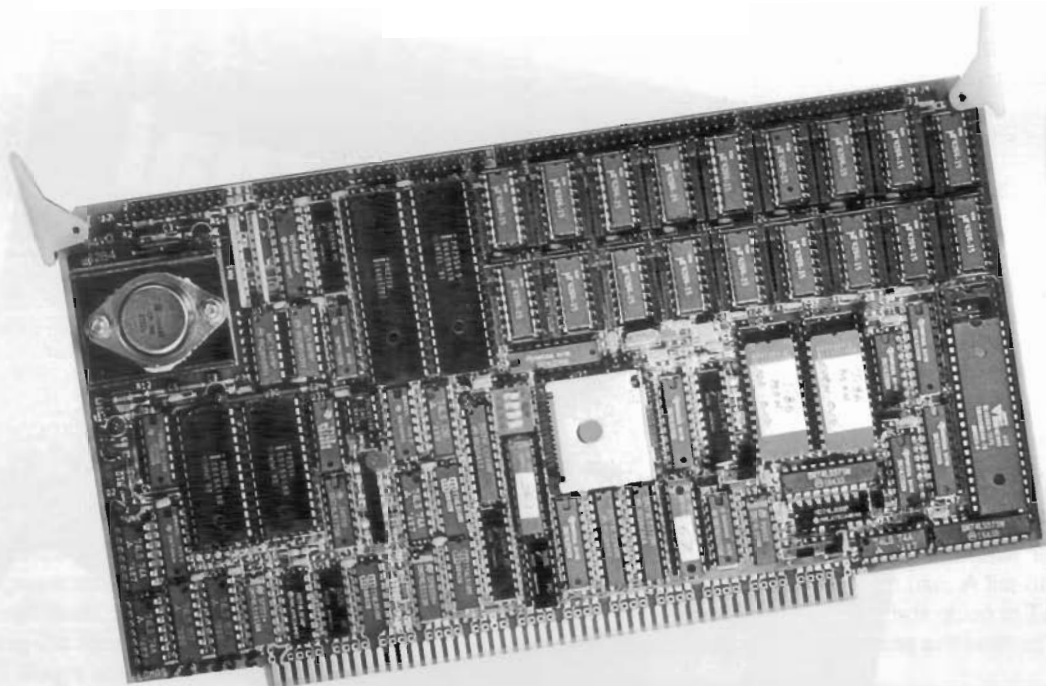
There is also a parallel channel controlled by a 8255A. The output is used as a printer port. The input is used by the monitor at boot time to read the setup switches, and thus it is not generally available.

The board supports any combination of two 8- and/or 5¼-inch floppy disk drives. This gives a great deal of flexibility in using existing equipment.

Dynamic memory is used with no wait states at either 128K or 256K bytes. Up to 1M byte of additional memory may be added.

The more sophisticated user may wish to alter the boot EPROMs. These may be enlarged to a whopping 64K if necessary.

The Thunder-186 conforms to the IEEE-696 standard with pins 65 and 66 additionally defined as external DMA requests. Hence, boards added to the system should not use these pins for their own functions. Added boards should also provide a full 20-bit address and 16-bit port decodes, or conflicts might arise in the system. For example, if a graphics board used port 28h but only decoded the lower 8 bits, a conflict would arise with the 80186 port FF28h which masks the interrupt sources.

SERIAL PORT 2 | SER./TERMINAL | PAR./PRINTER | 8" FLOPPY DISK | 5¼" FLOPPY DISK

JP9

off on
1
2
3
4

SW1

JP8

JP5

JP3 JP2

J
P
7

JP6

JP1

Thunder-186 switch and jumper settings to use with 9600-baud terminal, 8" drives, auto boot, 8K of EPROM, and no slave boards. Red rectangles indicate installed shunts. Red dots indicate positions of microswitches.

The S-100 phantom line is asserted during memory accesses within the Thunder-186 board. This may be important to users with additional boards.

SETUP

Configuring the Thunder-186 is very simple. The principal options are chosen by means of a 4-slide DIP switch. Two switches select one of four baud rates for the terminal. Another switch determines if boot is to be done from 8- or 5¼-inch floppies. The remaining switch allows the user to not boot, but rather to run an on-board program called the monitor. This monitor provides several simple and useful commands. They are discussed below in the monitor section.

Jumper JP1 allows advanced users to install their own boot sequence with up to 64K of EPROMs (2xAMD 27256). Normally this is left as set at the factory.

Jumper JP2 sets the floppy disk drive write precompensation to 125 or 250 nanoseconds. See your disk drive manual to determine the setting for your drives.

Jumper JP3 is for users with slave processors on the same S-100 bus. It provides reset to slaves on master reset.

The interrupt jumpers (JP5) allow the user to connect the eight S-100 interrupt vectors to any of the four 80186 primary interrupt vectors. It may be necessary to alter these to match the requirements of additional boards.

A terminal with normal handshaking is required to boot the system. The floppy drives need not be hooked up to use the monitor (a nice feature). The board should be used with a terminated S-100 motherboard. This is very important if other boards are to be used in the bus. If your bus is not terminated, purchase a small terminator card from someone like Viasyn.

OPERATING SYSTEM

The operating system supplied with the board is the popular Concurrent CP/M-86. It allows multiusers and multitasking. Thus, multiple jobs may be run from the same board by time-slice task swapping. In the "single user/multitasking" environment, a special code, called the lead-in character, is typed to switch virtual terminals. The lead-in character for switching terminals may affect other software (such as my editor), but the manual gives instructions for changing it.

A parallel printer can be connected to one of the headers. Beware that this printer header is displaced one row- so pin one of the header cable needs to be connected to pin three of the connector. Alternatively, the second serial port may be used for the printer. This is done by running a command file after boot or reassembling the operating system.

A routine to do a track-for-track disk copy is not available among the operating system functions. A fairly simple alternative technique is used to copy the system tracks using the monitor.

MONITOR

The monitor is a program burned in EPROM which is available at boot time (by setting a DIP switch). It first performs some self-tests (another nice feature) and board setup, and then allows the user to perform simple board level operations. These include hex arithmetic, port I/O, raw disk I/O, examining and changing memory, and running and tracing programs. The monitor is powerful and simple to use. A list of the monitor commands is given in Table 1. Unfortunately, the self-tests at boot clear

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MONITOR COMMANDS:

B: BOOT SYSTEM FROM FLOPPY DISK

C: CONVERT DECIMAL TO HEX

D: DUMP MEMORY SECTION (HEX AND ASCII)

E: ENTER DATA INTO MEMORY MANUALLY

F: FILL SECTION OF MEMORY WITH VALUE

G: GO. LOAD REGISTERS, SEGMENTS, IP AND START EXECUTION

H: HEX ARITHMETIC (+,−,*,/)

I: INPUT FROM I/O PORT

L: LOAD DISK SECTORS TO MEMORY

M: MOVE MEMORY SECTION

O: OUTPUT DATA TO I/O PORT

R: DISPLAY REGISTERS, SEGMENTS, AND FLAGS. (SEE GO)

S: SEARCH MEMORY SECTION FOR DATA STRING

T: TRACE INSTRUCTION CYCLES. (SINGLE STEP CAPABILITY)

V: VERIFY MEMORY SECTION WORKS

W: WRITE MEMORY TO DISK SECTORS

Table 1. *Monitor commands of the Thunder-186. In addition, the on-board monitor sets up peripherals, automatically sizes memory, and performs memory tests.*

memory, so software bugs that jam the system are not easily traced.

DOCUMENTATION

The Thunder-186 suffers from a malady common to many products these days — a lack of good documentation. The manual leaves out some fairly major things, like the function of certain jumpers and the printer cable trick. In defense, however, the company has always been very responsive to questions and helpful in solving specific problems.

CONCLUSIONS

The Thunder-186 is an excellent computer that offers the flexibility of the S-100 bus. That makes it a great choice for both the casual programmer and the sophisticated OEM. The Thunder more than lives up to its claims, and it offers a good deal more versatility than many other boards on the market.

The board is available at a discount from Integrated Microsystems, as well as from other dealers. The unit may also be purchased as part of a system with chassis, floppy drives, etc. Options include a hard disk drive, and more memory.

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