SLICER™

SLICER COMPUTERS INC.

2543 Marshall Street N.E., Minneapolis, MN 55418 • (612) 788-9481

Design & Manufacture of Slicer Computers, Hardware, Software & Systems

The SLICER Single Board Computer

Easy Kit

An Easy Kit includes the components we feel are hard to get through your local sources.

BARE	EASY		
	✓	1.	Intel 80186 and socket
	✓	2.	Double deck sockets (Qty of 16 - RAM sockets)
	✓	3.	RAM controller chip (TMS4500)
	✓	4.	Data separator chip (FDC 9229B)
	✓	5.	Serial port chip (2 ports) (SC2681)
✓	✓	6.	Two EPROMS (2732) with monitor and I/O routines for CPM/86
✓	✓	7.	Two crystals-One for floppy disk controller and CPU (16 MHz)-One for serial interface (3.6864 MHz)
	✓	8.	One buffer chip for SASI interface (74AS580)
	✓	9.	One resistor pack
✓	✓	10.	An 8" single-sided, single-density disc containing source code of monitor and BIOS
✓	✓	11.	Documentation. Slicer manual. Intel data and application sheets
✓	✓	12.	Weidmuller power connector
✓	✓	13.	Slicer Board

Technical Specifications

CPU

Intel 80186 with 3 timer/counters, 2 DMA channels and interrupt controller. Instruction set upwards compatible with 8086/88.

Memory

Up to 32K bytes of ROM, using 2 of 2732, 2764, or 27128 EPROMS. 128K bytes or 256K bytes of dynamic RAM, using the 4164 150 n sec parts are required for reliable 8 MHz operation. The TI TMS 4500 DRAM controller allows operation without mandatory wait states at 8 MHz clock frequency.

Serial Port

Two serial ports with independently programmable baud rates up to 38.4K Bd. A Signetics SC2681 is used.

Floppy Disk Interface

The combination of a 1797 controller plus a FDC 9229B data separator allows the use of 8" and 5.25" disks, double density and double sided. Switching between 8" and 5.25" drives under program control is possible.

SASI Interface

This interface allows the connection to a Winchester controller. Support for the Xebec S1410 controller and Western Digital WD1002SHD is provided.

Expension Interface

A 90-line expansion interface provides buffered data, address and control busses.

Power Supply

+5 volt, ±5% at 3 ampere max.
+12 volt, ±10% at 60 milliampere max.
−12 volt, ±10% at 50 milliampere max.

Software

Two-stage monitor, the first stage serves for the initial debugging of the board and requires no RAM to run. The second stage offers various commands for peripheral and program debugging and the I/O routines with the links to the CPM86 BIOS.

Detailed Description

The SLICER is a high performance single board computer using the most advanced components currently available. It incorporates a 16-bit CPU, RS 232 serial ports, floppy and hard disk support, 256K bytes RAM and 32K bytes EPROM on a double sided 5.85- by 11.75-inch circuit board. The system is fully expandable via two expansion connectors which not only have address and data signals, but also programmable timer inputs and outputs, DMA control, peripheral chip select lines, memory chip select lines, interrupt request inputs and CPU and baud rate clocks. Address, data and control lines are fully buffered for trouble-free expansion.

Many of the SLICER system capabilities are due to the capabilities of the Intel 80186 CPU. Not only is this CPU fully software compatible with the 8086 and 8088 processors, but it also incorporates such on chip peripherals as DMA controllers, interrupt controller, timer counters and programmable chip select lines. It is a superior microprocessor for highly integrated systems.

The SLICER was designed for hobbyist and O.E.M. applications. It was designed to allow the hobbyist a low-cost means of entering the 16-bit world and also to allow expandability as needs change. It was also designed to meet the needs of most O.E.M. applications by providing a large amount of memory, by meeting mass storage requirements and also by providing system expansion capabilities.

The 80186 CPU runs at 8 MHz or 6 MHz using 16 MHz or 12 MHz input. One on-chip interrupt channel is used for serial communications and another is used for floppy disk control, leaving two channels available to the user. One DMA channel is dedicated to the floppy disk controller while the other is shared between the SASI hard disk port and the expansion boards. The two external timer channels are free to be used by the third timer channel is used as a systems timer. Three unused peripheral select lines are left for the user as are two memory select lines.

The dynamic RAM memory array may be partially populated for a 128K byte memory system, or fully populated for the full 256K bytes of memory. To achieve this size of memory array in such a small area special sockets are used which allow one DRAM chip to be placed atop another. Of course the industry standard 64K by one DRAM circuits are used. The DRAM parts are 150 nsec parts. No mandatory wait state operation is used to provide the highest possible system performance.

The SLICER (continued from page 1)

The on-board EPROM sockets may use 2732, 2764 or 27128 EPROM parts. In all cases two parts must be used since the CPU has a full 16-bit data bus. This memory is accessed at reset, while executing the monitor program, while performing I/O calls and when responding to programmed interrupts. The board is provided with two EPROMs containing an excellent monitor program and operating system boot routines.

The two RS232C serial ports use the Signetics SC2681 serial communications circuit. This chip has independent on-chip baud rate generators which can be programmed for any standard baud rate between 50K baud and 38.4K baud. Channel A is used as the console port and is fully interrupt driven. Channel B may be used as a printer port, modem port, etc. Handshaking signals are provided on both ports.

The floppy disk controller is the 1797 single/double density controller and can simultaneously control any combination of up to four 3.5" micro disk drives, 5.25" mini disk drives or 8" drives. The drives may be a mix of single- and double-sided and single- or double-density. Write precompensation is selectable over a wide range and is entirely digital, eliminating the errors associated with analog systems.

The industry standard SASI hard disk controller port allows mass storage of many megabytes. Data transfer can proceed at up to 2M bytes per second, allowing rapid manipulation of data.

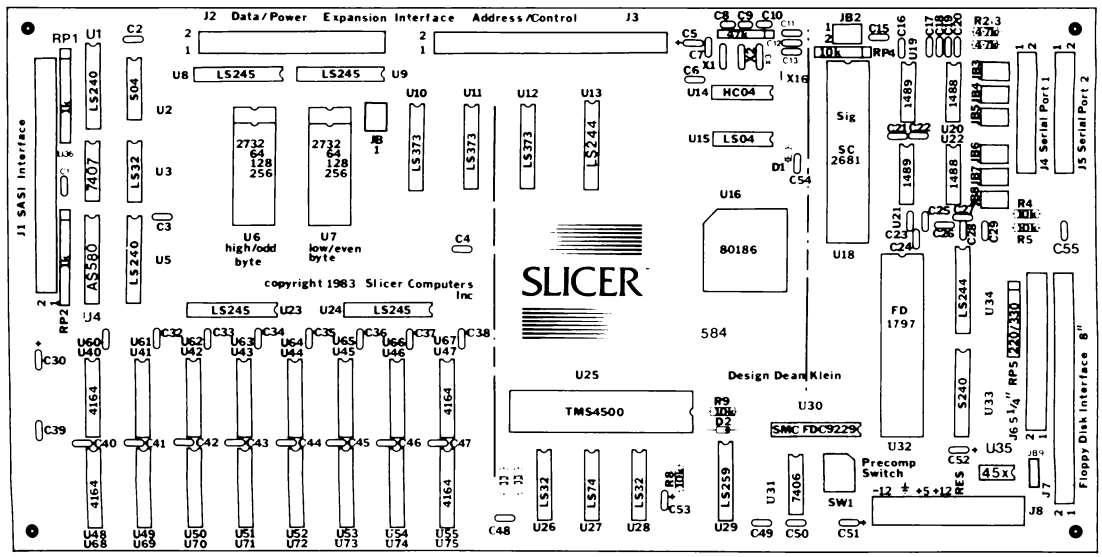
Expansion Interface:

											SASI				TMR0								
A1	A3	A5	A7	A9	A11	A13	A15	A17	A19	$\overline{BHE}$	DRQ	$\overline{RD}$	ALE	$\overline{S1}$	$\overline{LCS}$	OUT	$\overline{DEN}$	$\overline{PCS6}$	$\overline{PCS4}$	$\overline{MCS1}$	INT2	GND	GND	GND
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
A0	A2	A4	A6	A8	A10	A12	A14	A16	A18	DT/$\overline{R}$	DRQ	$\overline{WR}$	$\overline{SO}$	$\overline{S2}$	WAIT	TMR1 OUT	TMR0 IN	$\overline{PCS5}$	$\overline{MCS0}$	INT3	16 MHZ	3.686 MHZ	CLK OUT	$\overline{RES}$
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49

+5V: 2 4 6 8 10 12 14 16 18 20

GND: 22 24 26 28 30 32 34 36 38 40

EXP IN	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	N.C.	$\overline{BUFFER\ ENABLE}$	INPUT ENABLED
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39



The SLICER Prototype Expansion Board

Technical Specifications

Features

For prototyping your latest designs or adding custom features to your SLICER, this board has a fully buffered address and data bus. A 4k I/O block is decoded and dedicated to the board. Up to four different blocks may be used, allowing up to four boards on a system. A large prototyping area is provided with power and ground bussing as well as plated through holes which allow soldered or wire-wrapped connections.

The SLICER System Expansion Board

The following partial kit forms are available:

BARE	3-PORT	MEMORY	
		✓	1. Ram controller chip (TMS4500)
	✓		2. Serial port chip (SC2681)
	✓		3. Clock chip (CDP6818)
		✓	4. TTL for memory
	✓		5. TTL for ports (include parallel port)
	✓		6. 32.768 KHz crystal for clock
	✓		7. Ni-cad battery
	✓	✓	8. Required resistors and capacitors
✓	✓	✓	9. Weidmuller power connector
	✓	✓	10. Required sockets and header strips
✓	✓	✓	11. Documentation
✓	✓	✓	12. Circuit board

Technical Specifications

Memory
Up to 256K bytes of dynamic RAM, using the 4164-150 nsec parts for operation at 6 MHz or 8 MHz.

Serial Ports
Two serial ports with programmable baud rates up to 38.4K Bd using Signetics SC2681 as on Slicer. Two additional ports using Zilog 8530 SCC with RS232C drivers/receivers on board, header connectors for other drivers/receivers provided.

Parallel Port
A Centronics type parallel printer port is provided. Software handshaking may be interrupt driven.

Real Time Clock
RCA CDP6818 Real Time Clock chip is used with on board Ni-cad battery for continuous timekeeping.

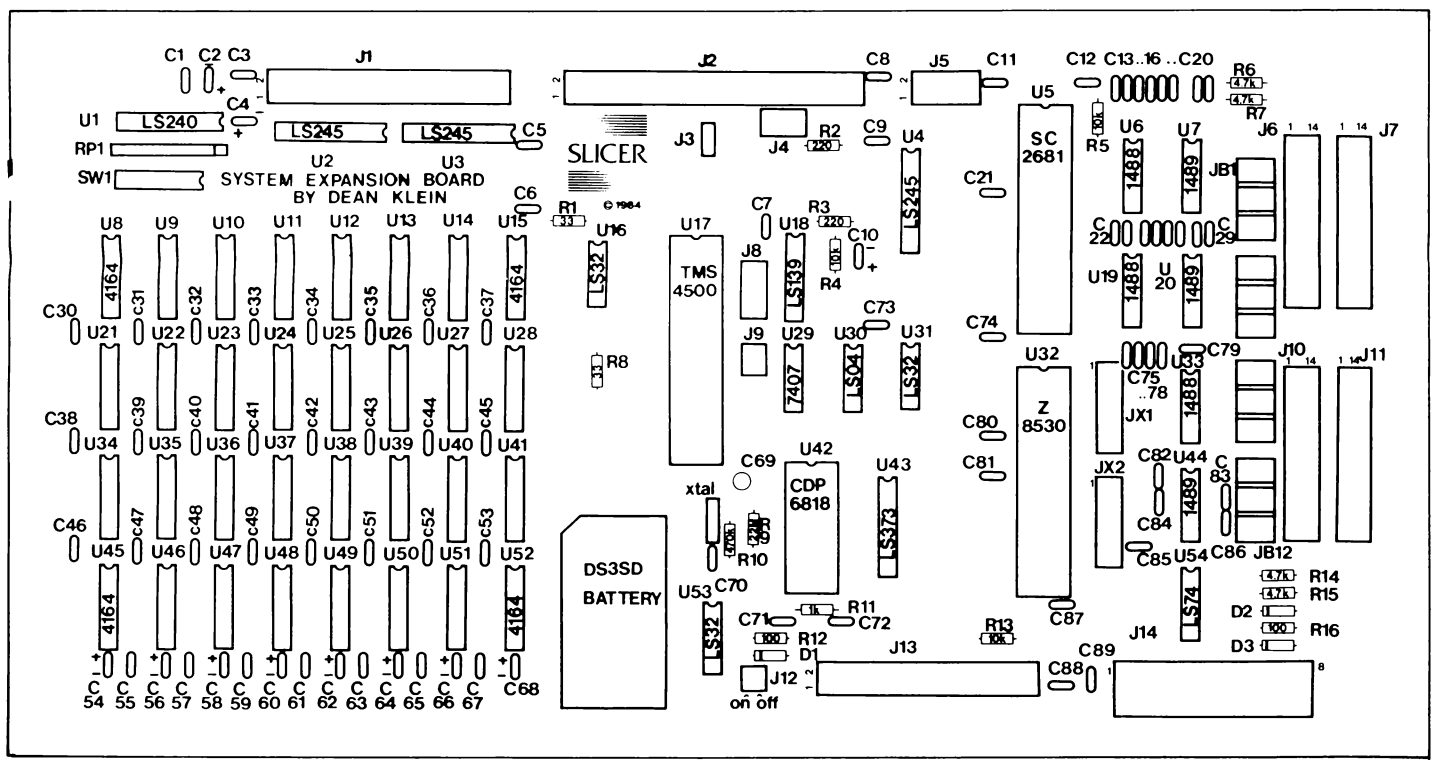
Detailed Description

The System Expansion Board was designed to add memory and ports to the SLICER. The memory array is a 128K by 16 array using 32 industry standard 4164-15 DRAM chips. The array may be partially populated to give 64K by 16 using 16 DRAMS. The memory controller is a TMS 4500, as on the SLICER. The DRAM chips are *NOT* stacked, as is the SLICER.

The Real Time Clock uses the CDP6818 clock chip, a 32.768 KHz crystal and a Ni-cad battery, for reliable, uninterrupted timekeeping. Provisions for an off-board battery are also provided.

Four RS232 serial ports are provided. Two are identical to those on the SLICER, using the SC2681. The remaining two are provided only on a Full Kit, using the Zilog Z8530 SCC. This chip is capable of synchronous as well as asynchronous communications. Header connectors are provided for using other drivers and receivers.

The parallel printer port is Centronics compatible and may be interrupt driven.



The SLICER PC Expansion Board

The following Partial Kits are available:

BARE	EASY	
	✓	1. HD6845 SP CRT controller
	✓	2. Two HM6264-15 Video rams
	✓	3. SCB2673B video attribute controller
	✓	4. 74LS322A shift register
	✓	5. Keyboard connector
	✓	6. Video connector
	✓	7. Resistor packs (2)
	✓	8. 1N5230 diode
	✓	9. 74HC04
✓	✓	10. PALs (2)
✓	✓	11. Crystals (2)
✓	✓	12. EPROMs, software & character generator (3)
✓	✓	13. Resistor, 37.4 ohm
✓	✓	14. Power connector
✓	✓	15. Circuit board, multi-layer
✓	✓	16. Documentation

Technical Specifications

PC Compatible Video System

Video system based on 6845 type CRT controller provides PC compatible video system. Two 6264 type 8k by 8 memories are used which allows up to four pages of text. An additional graphics mode allows the use of this memory as a bit mapped 640 by 200 screen. Video output is separate sync or composite sync. Separate sync outputs are PC compatible.

PC Compatible Keyboard Input

A connector for a PC type keyboard is provided. The software provided recognizes this as the console keyboard. Keyboard scan codes are also provided.

PC Expansion Bus

Two PC type cardslots are provided for expansion of I/O or for addition of color graphics cards. Circuitry converts the fast 16-bit SLICER bus to the slower 8-bit PC bus. Memory refresh is not supported on this bus.

Software

Two EPROMs contain all the necessary routines to run this board. The SLICER debug monitor automatically detects the presence of the board and uses it as the console device.

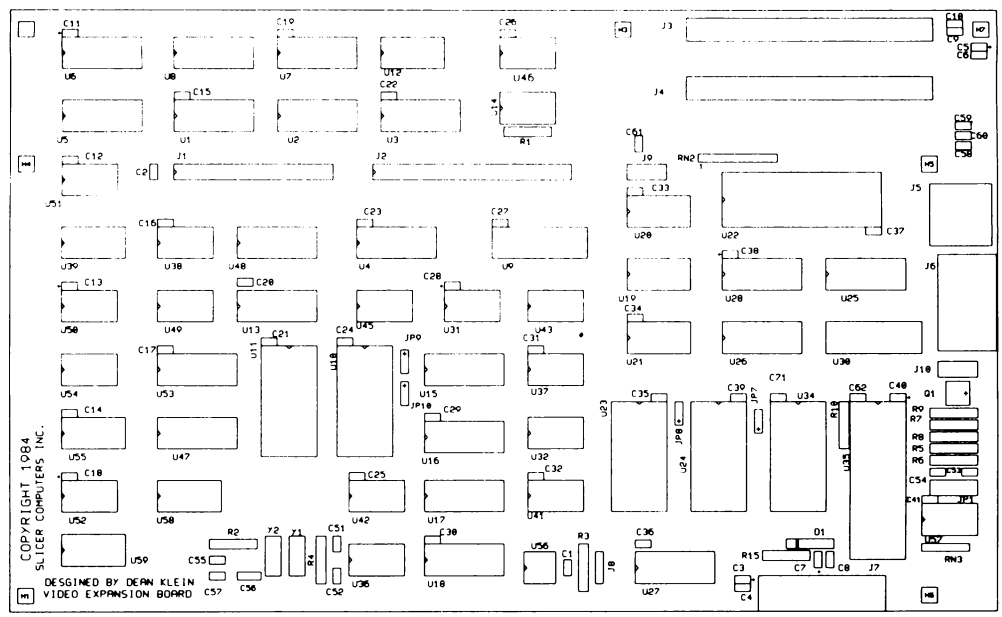
Detailed Description

The SLICER PC Expansion Board was designed to provide the SLICER with IBM PC compatible monochrome video as well as an IBM PC compatible keyboard port. The video controller is the Hitachi HD6845 SP which is hardware compatible with the PC's controller. The video memory is much larger than the PC's which allows multiple pages to be rapidly accessed. In addition, the video memory is a full 16 bits wide which allows both the character and its attribute to be accessed in a single bus cycle. The hardware provides glitch-free operation which allows the CPU to access the video ram anytime, not just during horizontal or vertical retrace periods. FAST!

The PC keyboard port allows a PC type keyboard such as the Keytronics KB5150 or any other PC keyboard to be used with the SLICER. These keyboards do not return ascii codes but rather they return a scan code whenever a key is depressed or released. The software decodes the scan code and keeps track of the state of the control, shift and similar keys. The keyboard is interrupt driven.

The PC expansion bus has two cardslots which may be used for adding input or output devices designed for the PC. It is also designed to support various color graphics boards, such as the Quadcolor I and II or other similar products. Note, however, that the PC method of memory refresh is not supported on this bus, but who would want to put slow 8-bit wide memory on a 16-bit CPU anyway!

Extensive use is made of PALs on this board. Many of the board's characteristics may thus be easily altered such as memory or I/O decoding and video attribute control.



The μSLICER 188

Technical Specifications

CPU
Intel 80188 8/16 bit CPU with 3 timer/counters, 2 DMA channels and interrupt controller. Instruction set upwards compatible with 8086/88. 8 bit data path to CPU.

Memory
A single 2764 or 27128 provides 8k or 16k EPROM space for monitor. 64k, 128k, 192k or 256k bytes of dynamic ram is provided using 4164FL8 150 nsec SIP RAM modules for high density, zero wait state performance at 8 MHz operation. The TI TMS 4500 DRAM controller is used as on the SLICER.

Serial Ports
Two serial ports with individually programmable baud rates up to 38.4k baud using the Signetics SC2681.

Floppy Disk Interface
The 1797 disk controller and FDC 9229B digital data separator allows the use of double density, single or double sided, 40 or 80 track drives.

SASI Interface
This interface allows the connection to a Winchester controller. Support for the Xebec S1410 and Western Digital 1002 SHD controller boards are provided.

Expansion Interface
A simple expansion bus is provided for future enhancements to the system.

Power Supply
+5 volt ±5% at 1.5 ampere max.
+12 volt ±10% at 60 milliampere max.
−12 volt ±10% at 50 milliampere max.

Physical
Identical in size to 5¼ disk drive. Mounting holes match those of a SASI hard disk controller card.

Software
Two-stage monitor as on SLICER. Standard SLICER operating systems (MS-DOS, CP/M-86 and Concurrent CP/M-86) run on this board as well.

Detailed Description

The μSLICER 188 was designed to take advantage of the latest in microcomputer technology and to offer it in as small a package as possible. Essentially it is a SLICER computer with only somewhat restricted capabilities. The CPU shares the same internal architecture as the 80186 as used in the SLICER. It has the same counters and timers as well as DMA channels and interrupt controller, but only an 8 bit wide data bus. How much this will actually affect the performance of the system will depend on the actual code executed since the CPU pre-fetches instructions.

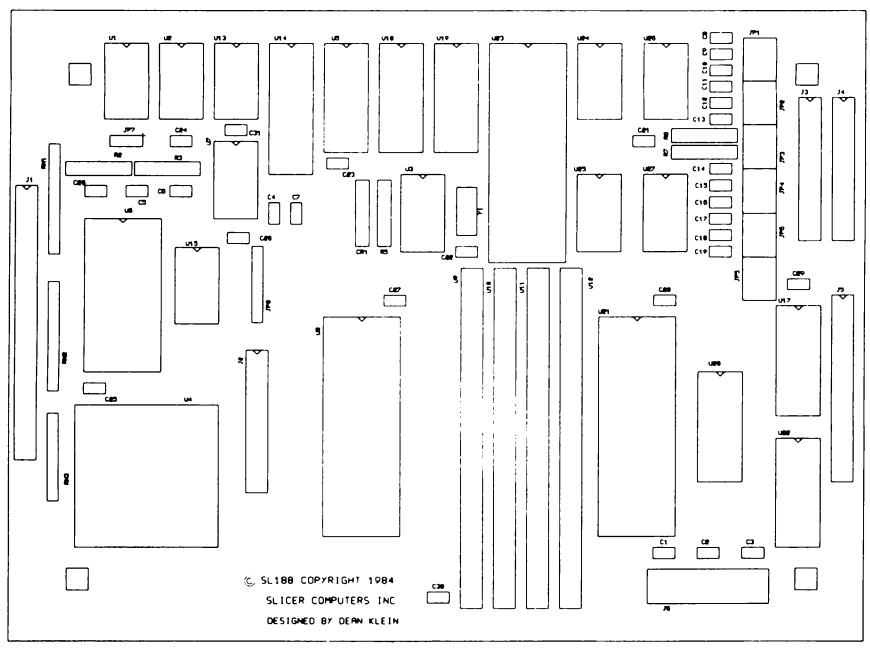
The dynamic RAM array uses TI 4164 FL8 SIP DRAM modules for highest density and reliability. These modules combine eight 64k DRAMs on a single module to provide 64k bytes on a single, space-saving package. The board uses four of these but may be partially populated to get a 64k, 128k, 192k or 256k system.

The single on-board EPROM socket may use a 2764 or 27128 EPROM. Since the data bus is only 8 bits wide only a single EPROM is used. This memory is accessed at power-up and for I/O operations. It also contains the nearly famous SLICER debug monitor.

The two serial ports are identical to those on the SLICER, using the Signetics SC2681 serial communications circuit. Port A is assigned as the console port and port B may be used as a printer or modem port.

The disk controller is the 1797. This is used with the FDC 9229 digital data separator as on the SLICER. No adjustments are required to the data separator as there might be with analog type systems. The write precompensation is also digital and is fixed. The disk controller supports two 5.25" disk drives which may be single sided, double sided, 40 track or 80 track drives. 8" drives are not supported.

The industry standard SASI hard disk controller port allows rapid transfer of data to and from hard disks, tape drives and other devices. Software support is provided for the Xebec S1410 and Western Digital 1002 SHD hard disk controller boards.



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Assembling SLICER Products

The parts count of the SLICER is quite low, which simplifies assembly.

Nevertheless, we recommend the purchase of kits only to persons with experience in electronic hardware and access to debugging tools like logic probes and oscilloscopes.

We intend to support kit builders with advice as far as possible but our resources are limited.

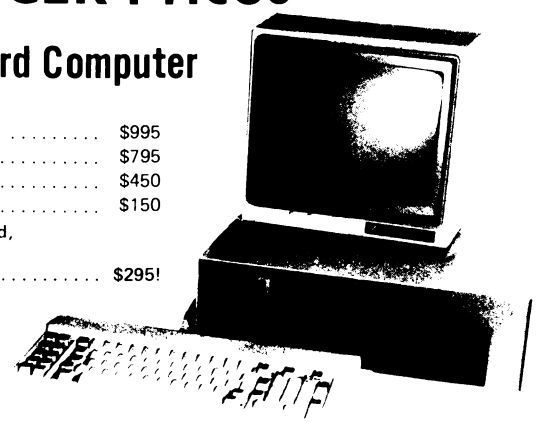
We will attempt to bring up your board if necessary, but we will in all likelyhood, charge you for this service, depending on parts and labor needed.

Finally, please let us know of problems and possible solutions, so that we can help others with similar problems.

Warranty on Assembled Slicer products: We give a standard 90-day warranty on assembled boards.

SLICER Prices

Slicer Single Board Computer



Assembled and Tested 8 Mhz	$995
Full Kit	$795
Easy Kit	$450
Bare Board	$150
New!! DOS KIT includes Bare Board, CPU and choice of MS-DOS or CP/M-86	**$295!**

The Slicer System Expansion Board

Assembled and Tested	$750
Full Kit	$575
Memory Board Kit	$395
3-Port Kit	$225
Bare Board	$95

The Slicer PC Expansion Board

Assembled and Tested	$600
Full Kit	$550
Easy Kit	$400
Not-So-Bare Board	$200

New!!

Western Digital 1002-SHD Hard Disk Controller

Assembled and Tested ..... Only $200!

New!!

The μ Slicer 188

Assembled and Tested ..... Only $700!

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Enclosure (alone)	$125
with 135W Power Supply	$245
with P.S. and two 80 track 5¼" Disk Drives	$695
10MB (formatted) 1/2 height 5¼" Hard Disk	$700
PC Compatible Keyboard	$150
PC Compatible Amber Monitor	$175

New!!

Super Enclosure System

Enclosure, Power Supply, 1/2 height
80 track floppy, 10 MB (formatted)
5¼" Hard Disk, Western Digital
1002 SHD Controller
All for Only ..... $1395!

New!! 8087 Math Co-Processor Board

(Requires removel of CPU socket)
This board requires a C-Step CPU and an 8 Mhz 8087. Kit with all parts except CPU and 8087 ..... $300!
8 Mhz 8087 ..... Call

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