1.1 Introduction

The Technico Super System 16 is a family of products which range from a single board computer (T99SS) to a fully assembled and tested computer system with floppy disk subsystem. As a user you may build your system from individual boards housed in your own chassis with your own power supply; or you may build a system from individual boards housed in the Technico Super System chassis; or you may chose to begin with a fully assembled tested system from us. This flexibility allows you to configure the system exactly to your requirements.

1.1.1 Processor

The SS16 system diagram illustrates the various components aviable in any of the Technico systems. The heart of all systems is the T99SS CPU board. The T99SS CPU board features:

- 9900 16-bit CPU
- Up to 2K bytes of RAM
- PROM resident monitor
- (Optional) EPROM resident line-by-line assembler
- (Optional) EPROM resident floppy disk/cassette tape handler
- RS232 or 20MA current loop asyncronous serial interface
- 16 bits of TTL parallel input/output
- Fully buffered data, address, and control lines for ease of system expansion.
- User selected program startup from user program in RAM or the EPROM monitor.

1.1.2 Memory Expansion Modules

Starting with the basic T99SS CPU board, you may add several additional expansion boards. Two of the expansion boards extend the amount of memory available to the processor. The first, T99ST static RAM module, extends the user RAM area by up to 32K bytes. The second memory expansion board, T99EP, expands the EPROM storage area. This board provides sufficient EPROM storage to hold such programs as the EDITOR/ASSEMBLER/LINKING LOADER (EAL) or Super BASIC. Other features of the T99ST RAM module are:

- 2114 1Kx4 static memories
- Memory protect
- Starting address selection in 2K byte increments
- Address inhibit in 2K byte increments
- Up to 32K bytes on a single module.

The T99EP EPROM program storage module offers:

- o 2708 or 2716 EPROM storage
- o Up to 32K bytes of storage (for 2716 EPROMS)
- o Starting address selectable in 2K byte increments

1.1.3 Peripheral Expansion Modules

In addition to the memory expansion modules, there is a growing list of peripheral expansion modules. The first of the peripheral modules is the T99CVM (color video monitor). This board provides all the necessary circuity to interface the CPU to a black and white or color video monitor. By addition of a simple external RF modulator, the T99CVM can be interfaced to a color TV set. Other features of the T99CVM board are:

- o 64 or 32 character lines
- o 16, 24, or 32 lines on the screen
- o 8 color selections and 8 intensity levels for each color
- o Reverse video on a character basis
- o Full upper and lower case ASCII
- o 3 character EPROM's allow user character sets in addition to the standard ASCII set. These additional character EPROM's can be used for limited graphic capability.
- o Video output to drive a color or black and white monitor or an RF modulator
- o 2K bytes of user RAM for additional program storage
- o Video monitor software contained in EPROM
- o ASCII encoded keyboard interface
- o A software controlled, hardware implemented, single step circuit which will allow setting breakpoints in EPROM

Another of the peripheral expansion modules is the T99128 parallel I/O module. This module offers 128 bidirectional, input/output, CRU bits. Other features of the T99128 module are:

- o 128 bits per module allowing up to 4096 bits in your system
- o Open collector outputs
- o Bidirectional outputs allow program verification of actual output bit state
- o External interface via 34 pin ribbon cables
- o Bits can be input or output in multiples from 1 to 16 bits.

Another I/O expansion module is the T9932 serial/parallel

and 32 bits of parallel I/O. Other features of the module are:

- Up to 6 RS232 or 20 MA current loop interfaces
- Baud rates to 19.2K baud
- Modem or terminal interface
- 32 bits parallel interface
- Open collector outputs with terminated parallel inputs

The T99FDC Floppy Disk controller module allows the addition of a floppy disk storage subsystem. The T99FDC intelligent controller features:

- Intelligent microprocessor based controller.
- 1, 2, 3, or 4 single sided (SA800) disk drives or 1 or 2 double sided disk drives (SA850)
- IBM format
- Includes EPROM resident disk operating system

1.1.4 Packaging

The Technico System allows various packaging options. The computer and boards may be operated stand alone outside a chassis, they may be installed in a user chassis, or they may be installed in the Technico System 16 chassis. When installed in the Technico System 16 chassis the system diagram illustrates the interconnection involved. The Technico system provides a power supply adequate for the CPU and one expanision memory. When additional memory or peripheral expansion modules are added an optional power supply is required. The front panel switches on the Technico System are:

- POWER - This turns on and off the primary AC power.

- RESET - Will reset the CPU and start execution as in power up. The RAM switch controls whether RESET will transfer control to the monitor or to a user program executing from RAM. When the system is initially started, RESET must go to the monitor since RAM storage is volatile and is destroyed when power is disconnected.

- RAM - This switch controls the manual or power-on reset action of the CPU. When in the RAM position, reset will be accomplished via the normal 9900 reset (a level zero interrrupt) using the interrupt vector in location 0 to 4. When in the other position, reset will be accomplished using the load vector stored at FFFC through FFFF. This will cause control

monitor. The system monitor will then wait for the user to type a sign-on character (the letter X) to determine the baud rate of the terminal. When the user types this character the monitor will respond with a prompt character indicating it is ready to accept user commands.

1.2 Software

No system is complete without software and the Technico system offers a variety of operational software from the monitor to a full FORTRAN IV compiler. The individual software packages are summarized below.

1.2.1 Mighty Monitor

A EPROM resident Mighty Monitor(Trade Mark of Technico, Inc.) is included in all Technico systems. This powerful 1K byte monitor offers various commands for program entry and debug. The monitor commands are:

- ALTER - Alter the contents of RAM memory
- BREAKPOINT - Set a breakpoint in a user program executing from RAM
- COPY - Copy a block of memory from one location to another
- DUMP - Dump an area of RAM or EPROM memory to the user terminal device
- GO - Transfer control to a user program or to other EPROM resident software
- HEX ARITHMETIC - Perform hexadecimal addition or subtraction to aid in computing addresses, etc.
- INSPECT - Inspect the current state of a CRU input bit
- LOAD - Reload a program from the terminal dumped using the DUMP command
- MODIFY - Modify a CRU output bit
- PROGRAM - Program a 2708 EPROM using the EPROM programmer on the T99SS CPU module. (Note: the EPROM programmer requires +28V for programming)
- SNAP - Set a snap shot in a user program executing from RAM

There are two extensions to the basic Technico Mighty Monitor. The first is a video monitor extension included with T99CVM. This monitor provides the necessary commands to save programs on audio cassette and interfaces the Mighty Monitor to an ASCII keyboard and color monitor. The other monitor extension provided with the digital tape player or floppy disk controller is the disk tape handler. This monitor extension provides all commands necessary to save, load, catalogue, delete, etc. programs on the floppy disk or

1.2.2 Instant Input Assembler

An optional EPROM resident line-by-line assembler, called the Instant Input Assembler (Trade Mark of Technico, Inc.), is available as a debug tool. The Instant Input Assembler accepts commands from either an RS232 asyncronous terminal or ASCII keyboard and video monitor combination if the T99CVM board is included in the system, and translates these assembly language commands to hexadecimal and stores them in memory. The Instant Input Assembler offers most standard assembler features except for symbolic labels. The unique difference is that it operates in this conversational mode. It accepts input from the terminal and immediately translates it to machine code. There is no need to edit and punch a tape first. Further, since the Instant Input Assembler is usually EPROM resident it is always ready for use. To activate the assembler you merely transfer control to it using the monitors GO command.

1.2.3 Editor/Assembler/Loader (EAL)

The Editor/Assembler/Loader (EAL) package is intended for more complicated system software development. The combined editor, assembler,and linking loader provide the necessary capabilities to develop large system software packages. Features of the editor/assembler loader package are:

- character oriented editor
- fully relocatable object code
- external reference and definition capability allow label resolution at load time
- assembler integrated with the editor allows assembly directly from the edit buffer, or from tape or disk
- conditional assemblies
- symbol table listing indicating symbols which are not referenced locally.

1.2.4 BASIC

One of the higher languages offered in the system is BASIC. The Technico version of BASIC is called Super BASIC because it offers numerous extensions over other BASIC interpreters. Some salient features of Super BASIC are:

- line editor
- line number resequencing capability
- nested IF
- integer, single presicision, double precision arithmetic capability
- complete string handling

- o disk file handling
- o program chaining
- o program is partially compiled for high speed execution
- o assembly language interface allows a BASIC program to call upon a subroutine written in assembly language
- o other extended functions allow CRU input and output directly in BASIC
- o compact size allows BASIC to operate with just 16K bytes of add on memory.

1.2.5 FORTRAN

A FORTRAN compiler is available for use on your system which provides a fully compatible IBM 360 FORTRAN. Due to its complexity the FORTRAN compiler requires a floppy disk unit and not less than 32K bytes of memory. FORTRAN can produce object code which can be loaded by EAL.

1.3 Organization of the Manual

This system manual provides both an overview of the Technico system and detailed information for several modules. Assembly documentation for any of the modules (e.g. T99SS-U, T99ST-U) or complete software documentation (e.g. Editor Assembler Linking Loader, BASIC) are provided separately. Documentation for the Instant Input Assembler, and the disk tape handler is provided in this manual.

As you can see, the Super System 16 is organized for maximum user flexibility. You can begin with a Super Starter T99SS CPU board, and expand to a full 65K floppy disk based mini-computer. It is our intention that you be satisfied with all the products you receive from Technico. If for any reason you are not fully pleased let us know and we will make every effort to provide immediate corrective action.

Technico is a fully franchised distributer of Texas Instruments. Therefore, all parts in your system are factory warranted. If during assembly of a kit you find a defective component, return the part to us for replacement. If the part has not been damaged by your assembly procedure, we will gladly replace it. We appreciate any other suggestions you may have concerning both our products and our services.

1.4 Bus Structure

The 9900 CPU has separate address and data buses. Since the address and data words are not multiplexed on a single bus, standard memories can be used with the 9900 without an external address latch.

The 9900 instructions build a 16-bit address word which

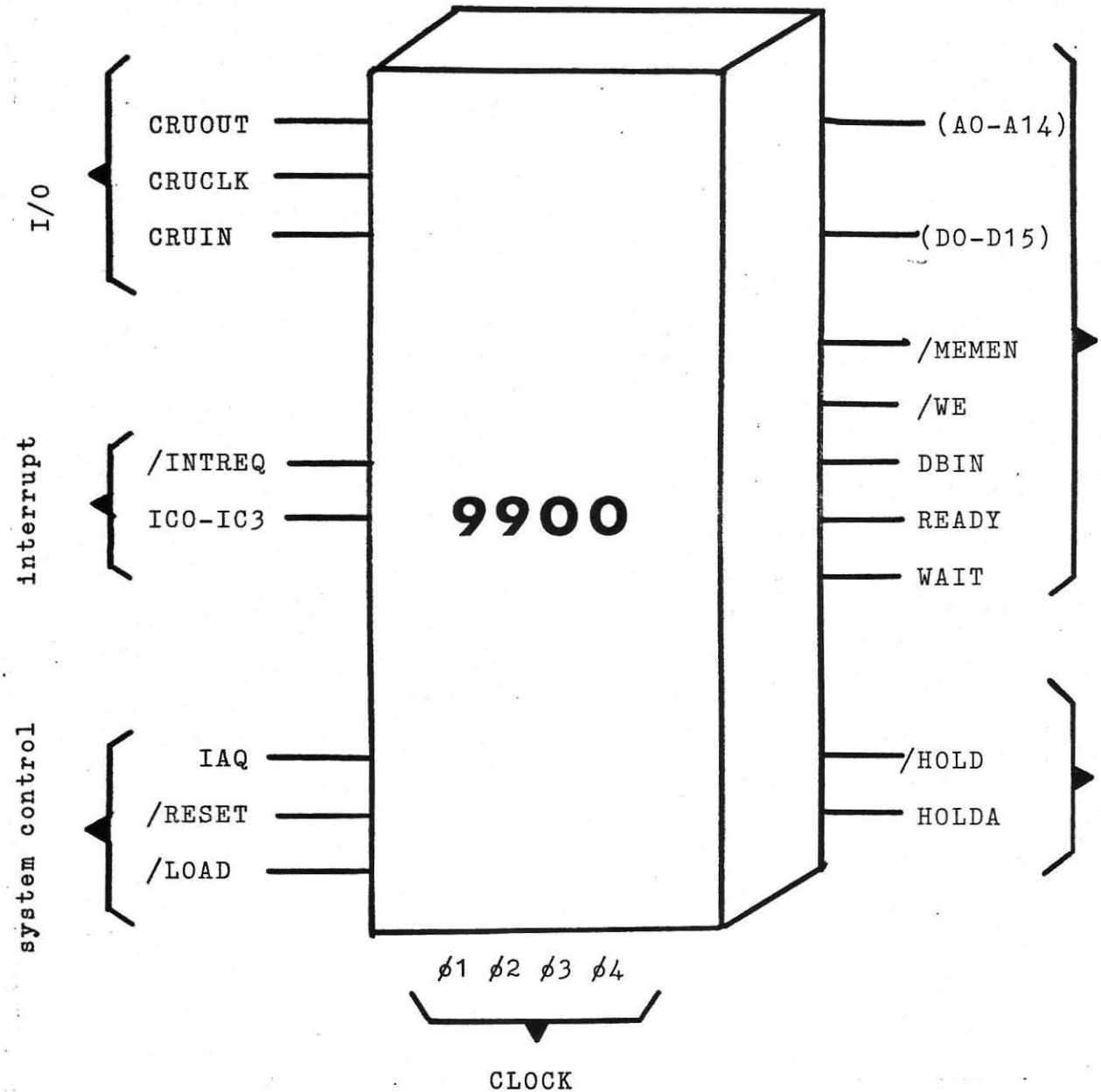
is used inside the CPU to select the byte and the other 15 address bits are passed to external memory to access a 32K x 16 address space. Thus, a 9900 system has a 16-bit data word and a 15-bit address word. Byte addressing is transparent to the memory.

The address bus is also used to select an I/O bit and to pass the external control functions (IDLE, etc.). The external control functions are not required in the most applications and therefore are not implemented in the Technico System. The address bus is used either to address memory (/MEMEN low), to address an I/O bit, or to pass an external control function. The 9900 interface signals are shown in Figure 1.1.

The data bus is used only to transfer data to and from the memory when /MEMEN is low. The ROM's and RAM's are the only devices connected to the CPU data bus. DBIN indicates whether the data bus is the input or the output mode. The data bus is normally in the output mode (DBIN low), and the memory data outputs should be enabled only when DBIN is high.

The Communication Register Unit (CRU) is a powerful command-driven I/O interface bus. The CRU employs three dedicated signals (CRUCLK,CRUOUT, and CRUIN) and the lower 12 bits of the address bus to interface with the CRU system. The CPU can set, reset, input, or test any bit in the CRU interface. The CPU sets or resets an output bit by placing the bit address on the address bus, the output data bit on CRUOUT, and a clock pulse on CRUCLK. The CPU reads or tests an input bit by placing the bit address on the address bus and testing CRUIN. Thus, CRU output operations are clocked by CRUCLK, while the CRU input is continuously decoding the address and transmitting the selected bit on CRUIN. The current CPU instruction, however, determines whether or not the current CRUIN input is used. The T99SS module provides 16 input and 16 output bits. One of the input bits and two of the output bits are used to control the RS-232/TTY interface and EPROM programmer.

The 9900 has fifteen user interrupt levels in addition to the /RESET and /LOAD functions. The presence of an interrupt is indicated by an external device driving /INTREQ low and placing the priority code on IC0 through IC3. The T99SS module provides priority encoding logic for eight unique levels of interrupt.


I/O
CRUOUT
CRUCLK
CRUIN
interrupt
/INTREQ
IC0-IC3
system control
IAQ
/RESET
/LOAD
9900
(A0-A14)
(D0-D15)
/MEMEN
/WE
DBIN
READY
WAIT
/HOLD
HOLDA
ø1 ø2 ø3 ø4
CLOCK

module	+5V	+12V	-5V
T99SS	1.5 AMP	.2 AMP	.1 AMP
T99ST	5 AMP	0	0
T99CVM	2 AMP	.2 AMP	.15 AMP
T99128	2.5 AMP	0	0
T99FDC	1.5 AMP	.4 AMP	.2 AMP
T99EP	1 AMP	.5 AMP	0
+EPROM	.005 AMP	.0600 AMP	.045 AMP

The power requirements shown above are typical maximums for each module. The power requirement for the T99EP is determined by adding the basic power requirement for the module to the power required for each EPROM.

-5V must not rise above -1V for more than 20ms while +5 and/or +12V are on, otherwise the processor may be damaged.

The Technico System has been designed for ease of expansion. Two methods of expansion are available. One is the board edge connector and the other is a sequence of 16-pin DIP sockets. All of the critical signals, including those for a computer control panel, are available on both the edge connector and the 16-pin DIP sockets. The individual jacks and pin assignments are described in the paragraphs below.

1.6.1 Address Bus

Edge	Jack	Signal
20	J4-1	Address Bit 0 (MSB)
22	J4-2	Address Bit 1
24	J4-3	Address Bit 2
26	J4-4	Address Bit 3
81	J4-5	Address Bit 4
83	J4-6	Address Bit 5
85	J4-7	Address Bit 6
87	J4-8	Address Bit 7
88	J4-9	Address Bit 8
86	J4-10	Address Bit 9
84	J4-11	Address Bit 10
82	J4-12	Address Bit 11
27	J4-13	Address Bit 12
25	J4-14	Address Bit 13
23	J4-15	Address Bit 14 (LSB)

1.6.2 Data Bus

Edge	Jack	Signal
55	J9-1	Data Bit 0 (MSB)
54	J9-2	Data Bit 1
56	J9-3	Data Bit 2
57	J9-4	Data Bit 3
58	J9-5	Data Bit 4
120	J9-6	Data Bit 5
118	J9-7	Data Bit 6
116	J9-8	Data Bit 7
115	J9-9	Data Bit 8
117	J9-10	Data Bit 9
119	J9-11	Data Bit 10
121	J9-12	Data Bit 11
122	J9-13	Data Bit 12
61	J9-14	Data Bit 13
60	J9-15	Data Bit 14
59	J9-16	Data Bit 15 (LSB)

Edge	Jack	Signal
50	J8-1	Interrupt-7 (lowest priority)
51	J8-2	Interrupt-6
52	J8-3	Interrupt-5
53	J8-4	Interrupt-4
111	J8-5	Interrupt-3
112	J8-6	Interrupt-2
113	J8-7	Interrupt-1
114	J8-8	Interrupt-0 (highest priority)

1.6.4 Control Signal (Group1)

Edge	Jack	Signal
95	J6-1	Ready (In)
96	J6-2	/HOLD (In)
98	J6-3	DBIN (Out)
38	J6-4	/WE (Out)
39	J6-5	/MEMEN (Out)
41	J6-6	HOLDA (Out)
42	J6-7	WAIT (Out)
102	J6-8	LOAD (In)
101	J6-9	/RESET (In)
40	J6-10	/RESET (Out)
100	J6-11	/LOAD (Out)
37	J6-12	IAQ (Out)
36	J6-13	CRUIN
35	J6-14	CRUOUT
34	J6-15	CRU CLOCK

1.6.5 Control Signal (Group 2)

Edge	Jack	Signal	
104	J7-1	/Phase one	
43	J7-2	/Phase two	TTL Level
44	J7-3	/Phase three	Processor Clocks
45	J7-4	/Phase four	
46	J7-5	Oscillator Out	
47	J7-6	Oscillator In	
49	J7-7	/Mode	
48	J7-8	/Prog	

Edge	Jack	Signal
16	J2-1	Bit 0 (LSB) -- Terminal IN
1	J2-2	Bit 1
2	J2-3	Bit 2
11	J2-4	Bit 3
12	J2-5	Bit 4
15	J2-6	Bit 5
14	J2-7	Bit 6
13	J2-8	Bit 7
10	J2-9	Bit 8
9	J2-10	Bit 9
8	J2-11	Bit 10
7	J2-12	Bit 11
6	J2-13	Bit 12
5	J2-14	Bit 13
4	J2-15	Bit 14
3	J2-16	Bit 15 (MSB)

1.6.7 Output Port

Edge	Jack	Signal
77	J1-1	Bit 0 (LSB) -- Terminal
62	J1-2	Bit 1 -- /Program Enable
63	J1-3	Bit 2
72	J1-4	Bit 3
73	J1-5	Bit 4
76	J1-6	Bit 5
75	J1-7	Bit 6
74	J1-8	Bit 7
71	J1-9	Bit 8
70	J1-10	Bit 9
69	J1-11	Bit 10
68	J1-12	Bit 11
67	J1-13	Bit 12
66	J1-14	Bit 13
65	J1-15	Bit 14
64	J1-16	Bit 15 (MSB)

Edge	Jack	Power/Ground
28-30,89-91	J5-1 to 4, 13 to 16	+5V
31-32,92-93	J5-5 to 6, 11 to 12	12V
33	J5-7,10	-5V
94	J5-8,9	+28V
17-19,78-80	J3-1 to 16	Ground

Note: +28V is used only to program EPROM's with the T99SS module.

WARNING

Be careful when applying power to J3/J5. A misconnection will seriously damage the system! Also, all unused pins are grounded.

Edge	Jack/Pin	Signal
1	J2-2	Bit 1 Input
2	J2-3	Bit 2 Input
3	J2-16	Bit 15 Input
4	J2-15	Bit 14 Input
5	J2-14	Bit 13 Input
6	J2-13	Bit 12 Input
7	J2-12	Bit 11 Input
8	J2-11	Bit 10 Input
9	J2-10	Bit 9 Input
10	J2-9	Bit 8 Input
11	J2-4	Bit 3 Input
12	J2-5	Bit 4 Input
13	J2-8	Bit 7 Input
14	J2-7	Bit 6 Input
15	J2-6	Bit 5 Input
16	J2-1	Bit 0 Input
17	J3-1 to 16	GND
18		GND
19		GND
20	J4-1	A0
21		
22	J4-2	A1
23	J4-15	A14
24	J4-3	A2
25	J4-14	A13
26	J4-4	A3
27	J4-13	A12
28	J5-4	+5
29	J5-13	+5
30	J5-14	+5
31	J5-11	+12
32	J5-12	+12
33	J5-7,10	-5
34	J6-15	CRU CLK
35	J6-14	CRU OUT
36	J6-13	CRU IN
37	J6-12	IAQ
38	J6-4	/WE
39	J6-5	/MEMEN
40	J6-10	/RESET OUT
41	J6-6	HOLDA
42	J6-7	WAIT
43	J7-2	Q2
44	J7-3	Q3
45	J7-4	Q4
46	J7-5	OSC OUT
47	J7-6	EXT CLK
48	J7-8	/PROG
49	J7-7	/Mode

51	J8-2	/6 Interrupt
52	J8-3	/5 Intrrupt
53	J8-4	/4 Interrupt
54	J9-2	D1
55	J9-1	D0
56	J9-3	D2
57	J9-4	D3
58	J9-5	D4
59	J9-16	D15
60	J9-15	D14
61	J9-14	D13
62	J1-2	Bit 1 Output
63	J1-3	Bit 2 Output
64	J1-16	Bit 15 Output
65	J1-15	Bit 14 Output
66	J1-14	Bit 13 Output
67	J1-13	Bit 12 Output
68	J1-12	Bit 11 Output
69	J1-11	Bit 10 Output
70	J1-10	Bit 9 Output
71	J1-9	Bit 8 Output
72	J1-4	Bit 3 Output
73	J1-5	Bit 4 Output
74	J1-8	Bit 7 Output
75	J1-7	Bit 6 Output
76	J1-6	Bit 5 Output
77	J1-1	Bit 0 Output
78		GND
79		GND
80		GND
81	J4-5	A4
82	J4-12	A11
83	J4-6	A5
84	J4-11	A10
85	J4-7	A6
86	J4-10	A9
87	J4-8	A7
88	J4-9	A8
89	J5-1	+5
90	J5-2	+5
91	J5-3	+5
92	J5-5	+12
93	J5-6	+12
94	J5-8,9	+28
95	J6-1	READY
96	J6-2	/HOLD
97		
98	J6-3	DBIN
99		
100	J6-11	/LOAD
101	J6-9	/RESET

103		
104	J7-1	Q1
105		
106		
107		
108		
109		
110		
111	J8-5	/3 Interrupt
112	J8-6	/2 Interrupt
113	J8-7	/1 Interrupt
114	J8-8	/0 Interrupt
115	J9-9	D8
116	J9-8	D7
117	J9-10	D9
118	J9-7	D6
119	J9-11	D10
120	J9-6	D5
121	J9-12	D11
122	J9-13	D12

The Super Starter Kit is designed for easy assembly. You don't have to be a microprocessor wizard to build and test your computer. If you carefully follow the assembly instructions, your computer will operate properly - the first time that power is applied.

To be sure that you don't make assembly errors, we highly recommend that you familiarize yourself with the kit prior to assembly. The best way to do this is to study the manual before proceeding. After you have read all of the manual you are set to begin. The following simple precautions will further minimize the chances of error:

- o Use care in handling the integrated circuits. All of the integrated circuits (I.C.) will be seriously damaged by static discharge. Carpeted areas are a problem. Even a minor static shock will ruin most I.C.'s.

- o Use the proper tools, and exercise care when soldering the components. In particular, use a low wattage iron - no more than 30 watts. Use only rosin-core solder. Acid core solder will ruin the kit and void any warranty. Keep the tip of your iron clean. A damp sponge is ideal for this purpose.

- o Never remove or install components when power is applied to the board. If you do, you will almost surely burn out some of the I.C.'s.

- o Prior to starting to assemble your kit, gather the necessary tools. The Super Starter Kit does not require an extensive set of tools. The following set should be sufficient:

1. needle-nose pliers
2. diagonal cutters
3. soldering iron (25 or 30 watts) Do not use a soldering gun because it gets much too hot.
4. solder (remember - use rosin-core)
5. volt-ohmmeter or continuity checker

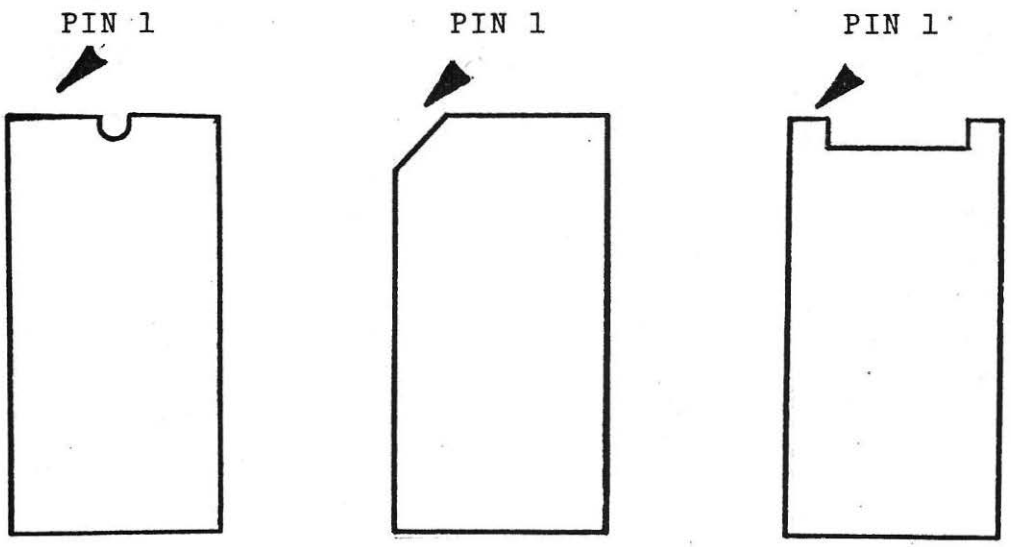
You are now ready to assemble the computer . Follow each of the instructions precisely, and in the order shown. All of the components are installed on the silk-screened side of the board, and are soldered on the other side. Be sure you have the board oriented with the silk-screen printing down when soldering components, and up when installing components.

Separate and check all parts against the parts list. If you find that any parts are missing, notify us immediately, and a replacement will be sent to you. Keep the parts separated for ease of assembly - paper cups or a small muffin tin is ideal storage.

Install the I.C. sockets shown below. Be certain to orient the socket properly. Each socket will have a distinctive marking to indicate pin one. Some sockets have a cut-off corner, others have a notch in the end with pin one. In any case, pin one must be aligned with the pin one indication on the printed circuit board as shown in Figure 1. Be certain that sockets are firmly against the PC board when you solder them. When you solder the sockets in place, be certain not to create a solder "bridge" between adjacent pins. This is the most common error in kit construction and can be very difficult to locate. Check each joint after soldering to eliminate any unwanted bridge.

( ) J1 16 pin socket
( ) J2 16 pin socket
( ) J3 16 pin socket
( ) J4 16 pin socket
( ) J5 16 pin socket
( ) J6 16 pin socket
( ) J7 16 pin socket
( ) J8 16 pin socket
( ) J9 16 pin socket
( ) J10 16 pin socket
( ) U23 64 pin socket (CPU)
Note: May consist of two 20 pin and two 12 pin socket strips.
( ) U15 18 pin socket (RAM)
( ) U16 18 pin socket (RAM)
( ) U17 18 pin socket (RAM)
( ) U18 18 pin socket (RAM)
( ) U19 18 pin socket (RAM)
( ) U20 18 pin socket (RAM)
( ) U21 18 pin socket (RAM)
( ) U22 18 pin socket (RAM)
( ) U30 18 pin socket (RAM)
( ) U31 18 pin socket (RAM)
( ) U32 18 pin socket (RAM)
( ) U33 18 pin socket (RAM)
( ) U34 18 pin socket (RAM)
( ) U35 18 pin socket (RAM)
( ) U36 18 pin socket (RAM)
( ) U37 18 pin socket (RAM)
( ) U1 16 pin socket
( ) U2 16 pin socket
( ) U3 16 pin socket
( ) U4 16 pin socket
( ) U5 16 pin socket
( ) U6 14 pin socket
( ) U7 14 pin socket
( ) U8 16 pin socket

( ) U11 20 pin socket
( ) U12 16 pin socket
( ) U13 14 pin socket
( ) U24 16 pin socket
( ) U25 16 pin socket
( ) U26 14 pin socket
( ) U27 14 pin socket
( ) U28 14 pin socket
( ) U38 16 pin socket
( ) U39 16 pin socket
( ) U40 16 pin socket
( ) U41 16 pin socket
( ) U42 16 pin socket
( ) U43 16 pin socket
( ) U44 16 pin socket
( ) U45 16 pin socket
( ) U52 16 pin socket
( ) U53 16 pin socket
( ) U54 16 pin socket
( ) U55 16 pin socket
( ) U56 16 pin socket
( ) U57 16 pin socket
( ) U58 14 pin socket
( ) U59 14 pin socket
( ) U48 24 pin socket
( ) U49 24 pin socket
( ) U50 24 pin socket
( ) U51 24 pin socket


PIN 1
PIN 1
PIN 1

The resistors should be installed in the order indicated below. Bend the leads to fit the distance between the mounting holes, insert the leads, push the resistor snug against the board, carefully solder it in place, and then trim off the excess leads. All resistor values are in ohms, and all resistors are 1/4 watt. For your convenience, the color code for each resistor is also shown. Figure 2 illustrates the complete resistor color code. Remember to install the resistors snug against the PC board.

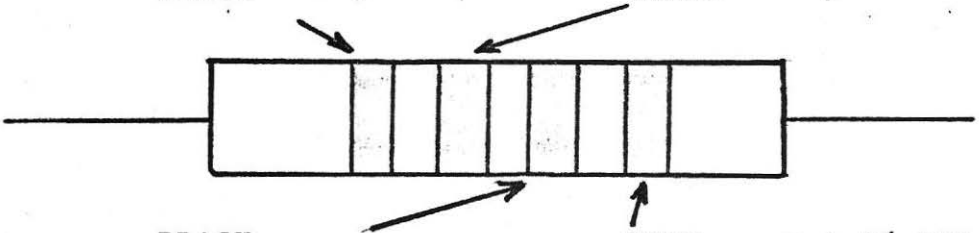
( )	R1	3.3K	orange, orange, red
Note:	There is no R2		
( )	R3	3.3K	orange, orange, red
( )	R4	3.3K	orange, orange, red
( )	R5	3.3K	orange, orange, red
( )	R6	3.3K	orange, orange, red
( )	R7	3.3K	orange, orange, red
( )	R8	3.3K	orange, orange, red
( )	R9	10K	brown, black orange
( )	R10	10	brown, black, black
( )	R11	20K	red, black, orange
( )	R12	51K	green, brown, orange
( )	R13	3.3K	orange, orange, red
( )	R14	3.3K	orange, orange, red
( )	R15	47	yellow, violet, black
( )	R16	10K	brown, black, orange
( )	R17	1K	brown, black, red
( )	R18	4.7K	yellow, biolet, red
( )	R19	3.3K	orange, orange, red
( )	R20	220	red, red, brown
( )	R21	220	red, red, brown
( )	R22	680	blue, grey, brown
( )	R23	10	brown, black, black
( )	R24	3.3K	orange, orange, red
( )	R25	1K	brown, black, red
( )	R26	3.3K	orange, orange, red
( )	R27	1K	brown, black, red
Note:	There is no R28		
( )	R29	10K	brown, black, orange
( )	R30	1K	brown, black, red
( )	R31	3.3K	orange, orange, red
( )	R32	3.3K	orange, orange, red
( )	R33	4.7K	yellow, violet, red
( )	R34	6.8K	blue, gray, red
( )	R35	470	yellow, violet, brown
( )	R36	3.3K	orange, orange, red
Note:	There is no R37		
( )	R38	3.3K	orange, orange, red
( )	R39	2.2K	red, red, red
( )	R40	1K	brown, black, red

Note: There is no R43

(✓)	R44	10 or 15	brown, black, black or brown, green, black
(✓)	R45	10 or 15	brown, black, black or brown, green, black
(✓)	R46	1K	brown, black, red
(✓)	R47	10 or 15	brown, black, black or brown, green, black
(✓)	R48	10 or 15	brown, black, black or brown, green, black
(✓)	SIP1	S.I.P.	10K Resistor Net 750-61-R10K
(✓)	SIP2	S.I.P.	10K Resistor Net 750-61-R10K

Note: Pin one of SIP1 and SIP2 are marked with a 1 on the part itself. Be certain to align that marking with the dot on the PC board.

BLACK	- 0	BLACK	- 0
BROWN	- 1	BROWN	- 1
RED	- 2	RED	- 2
ORANGE	- 3	ORANGE	- 3
YELLOW	- 4	YELLOW	- 4
GREEN	- 5	GREEN	- 5
BLUE	- 6	BLUE	- 6
VIOLET	- 7	VIOLET	- 7
GRAY	- 8	GRAY	- 8
WHITE	- 9	WHITE	- 9



BLACK	-	GOLD	= ± 5% TOL.
BROWN	- 0	SILVER	= ± 10% TOL.
RED	- 00	NO BAND	= ± 20% TOL.
ORANGE	- 000		
YELLOW	- 0000	Example:	RED RED ORANGE
GREEN	- 00000		2 2 000 =22K
BLUE	- 000000		

Each capacitor should be installed in the order indicated below. Insert the leads into the board, carefully push the capacitor snug against the board, solder it in place, and then trim off the excess leads. All values shown below are in in microfarads unless otherwise indicated. Many of these capacitors are bypass capacitors used to minimize electrical noise on the board and insure "glitch" free operation. These bypass capacitors are not shown on the schematic. If disc capacitors are enclosed, :he value is printed on them. If color coded capacitors are included, the resistor color code is used to determine the value. All of the electrolytic capacitors must be properly oriented on the board. One end of the capacitor is marked with a "+" or a solid color strip. This end of the capacitor must be positioned as indicated by the "+" on the board. Since these are used to filter the power, proper orientation is essential or the kit will be damaged when power is applied.

In some cases the capacitance value is printed on the capacitor in the form of a three digit number, with the first two digits indicating the number of zeroes to be added to the right (as in the resistor color code). For example, 470 indicates 47 picofarads and 104 indicates 100000 picofarads, or 0.1 microfarads. As another example, C22 is nominally 680 pf. But your kit may have a capacitor marked CK05/681K. The 681K means that the capacitor is 680 pf. This is the capacitor that you would use for C22 in this case.

( ) C1 .1
( ) C2 .1
( ) C3 .1
( ) C4 .1
( ) C5 .1
( ) C6 .1
( ) C7 .1
( ) C8 .1
( ) C9 .1
( ) C10 .1
( ) C11 .1
( ) C12 .1
( ) C13 .1
( ) C14 .1
( ) C15 .1
( ) C16 22pf (12pf or 15pf if crystal used)
( ) C17 47 mf (elcectrolytic- see note above)

Note: Install the crystal in place of C18 if supplied with your kit. If the crystal is installed, C16 is then 12 or 15pf.

( ) C19 .1
( ) C20 .1
( ) C21 .1
( ) C22 620pf or 680 pf
( ) C23 .1
( ) C24 2.2 (electrolytic - see note above)

Warning: Do not install C25. The silkscreen is improperly marked for C25 and if installed the kit will not function! C25 is not required for proper operation.

( ) C26 .1
( ) C27 470pf
( ) C28 .1
( ) C29 2.2 (electrolytic - see note above)
( ) C30 .1
( ) C31 2.2 (electrolytic - see note above)
( ) C32 .01
( ) C33 2.2 (electrolytic - see note above)
( ) C34 2.2 (electrolytic - see note above)
Note: There is no C35
( ) C36 .01
( ) C37 .1
( ) C38 .1
( ) C39 .1
( ) L1 .47 microh. inductor
(Looks like a large resistor)

All of the diodes are the same - 4148. They must be properly oriented on the board. One end of the diode is marked with a band. This banded end must be positioned as shown on the board. Since diodes are used to prevent current flow in one direction, reversing them will burn out your kit!

( ) CR1 4148
( ) CR2 4148
( ) CR3 4148

There are three different types of transistors in the Super Starter Kit, so be careful to install the proper type. Each transistor has three pins, and must be properly oriented. If you look at the transistor from the side that is flat (pins facing down), the pins are (from left to right) - emitter, base, and collector. Be sure to orient the emitter pin as shown on the board. If not properly oriented, the transistor will be damaged.

( ) Q1 2N3906
( ) Q2 2N3904
( ) Q3 2N3904
( ) Q4 2N3904
( ) Q5 2N3904
( ) Q6 2N4401 (or TIS111)
( ) Q7 2N4401 (or TIS111)
( ) Q8 2N3904

All integrated circuits must be properly positioned. Pin one of the IC is indicated by a small dot or number one in the corner, or by a notch at one end of the chip. Pin one must be positioned as shown on the board. Install the I.C.'s listed below into the sockets soldered to the P.C. board earlier.

Note: A non-LS part may be substituted for an LS part. That is, 74155 for a 74LS155. LS parts may not be substituted for those marked as non-LS parts.

( ) U1 74LS259
( ) U2 74LS259
( ) U3 74LS251
( ) U4 74LS251
( ) U5 74LS155
( ) U6 74LS40
( ) U7 74LS60
( ) U8 74LS156
( ) U9 74LS74
( ) U10 74LS362
( ) U11 74LS377
( ) U12 74123
( ) U13 74LS32
( ) U18 4042 or 2111
( ) U22 4042 or 2111

Warning: The CPU, U23, should not be installed at this time. It will be installed later after the integrity of the board has been verified.

( ) U24 74LS367
( ) U25 74LS148
( ) U26 74LS32
( ) U27 74LS00
( ) U28 74LS04
( ) U33 4042 or 2111
( ) U37 4042 or 2111
( ) U38 74LS367
( ) U39 74LS367
( ) U40 74LS367
( ) U41 74LS367
( ) U42 74LS367
( ) U43 74LS367
( ) U44 74LS367
( ) U45 74LS367
( ) U48 2708 EPROM Monitor
( ) U49 2708 EPROM Monitor
( ) U52 74LS367
( ) U53 74LS367
( ) U54 74LS367

( ) U57 74LS367
( ) U58 74LS32
( ) U59 74LS74

If you purchased the memory expansion capability, install those I.C.'s. The available expansion areas are:

( ) RAM 1
( ) U21 4042 or 2111
( ) U36 4042 or 2111
( ) U17 4042 or 2111
( ) U32 4042 or 2111

( ) RAM 2
( ) U20 4042 or 2111
( ) U35 4042 or 2111
( ) U16 4042 or 2111
( ) U31 4042 or 2111

( ) RAM 3
( ) U19 4042 or 2111
( ) U34 4042 or 2111
( ) U15 4042 or 2111
( ) U30 4042 or 2111

( ) EPROM
( ) U51 2708
( ) U50 2708

Note: The optional EPROM's can be programmed by the Super Starter Kit itself. Just put a blank EPROM in each socket, and then use the monitor to save your program in EPROM. Refer to the monitor section for detailed instructions.

Install the jumper wires to select the proper memory addressing. The Super Starter Kit allows you to rearrange the memory addressing allocation. The only restriction involves the EPROM monitor. If you are using the monitor, then the monitor EPROM must be located at >F800 and RAM must be located at >0000. If you are not planning to use the monitor, or your application requires a special address allocation, then refer to the schematic and determine for yourself what jumper configuration is required. If you want to use the standard kit configuration, then install the jumpers as follows:

( ) JW1 (in) to JW1 (out)
Note: JW2 to JW4 are not used
( ) JW5 (in) to JW5 (out)
( ) JW6 (in) to JW6 (out)
( ) JW7 (in) to JW7 (out)
( ) JW8 (in) to JW8 (out)
( ) JW10 (in) to JW10 (out)
( ) JW11 (in) to JW11 (out)
( ) JW12 (in) to JW12 (out)
Note: JW13 is not used

Note: JW12 may not be marked on the PC board. The jumper is located directly to the right and left of the marking for U28. That is, JW12 should cross directly through the silkscreen printing "U28".

The Super Starter Kit includes 32 bits of I/O (16 bits in and 16 bits out). The monitor uses three of these bits. It is possible that you may not want to use the monitor, and provisions have been made for removing the monitor related I/O. If you are using the monitor, install the following jumpers. If not, simply leave them out, and the monitor I/O is disabled.

( ) JW9 (in) to JW9 (out)
( ) JW14 (in) to JW14 (out)
( ) JW15 (in) to JW15 (out)

There are two different types of switches supplied with the kit, namely SPST and momentary contact switches. The first step is to separate them from each other. The momentary contact switch is the one which does not "latch". That is, if you move its handle it will spring back when it is released. The two SPST switches can be installed in either direction, but the momentary contact one must be properly oriented. The handle of the switch must face the processor. It is very important that the switch be installed correctly or the processor will be continually halted!

( ) SW1 - SPST
( ) SW2 - momentary contact
( ) SW3 - SPST

Note: SW3 may not be marked on the PC board. It is located in the three larger holes between U11 and U12.

The board has been assembled, but before applying power, you should test for short circuits which might seriously damage the kit. Using a volt-ohmmeter or a continuity checker, check the resistance between the pins of the processor as described below. Each reading should indicate a high resistance or a very dim glow of the light. If any of them show a zero resistance or a bright lit light, then you have a short. If you find a short, you must recheck all of your connections until the problem is located and repaired. If power is applied to the kit in the presence of a short circuit, all of the I.C.'s may be damaged!

(✓) Pin 1 (-5V) and Pin 26 (GND)
(✓) Pin 1 (-5V) and Pin 2 (+5V)
(✓) Pin 1 (-5V) and Pin 27 (+12V)
(✓) Pin 2 (+5V) and Pin 26 (GND)
(✓) Pin 2 (+5V) and Pin 27 (+12V)
(✓) Pin 27 (+12V) and Pin 26 (GND)

If the kit has no power shorts, then you are ready to apply the power. If you have located any shorts, DO NOT apply power All of the Super Starter power is obtained via the 16-pin jacks or the edge connector. If the jacks are used, all of the pins of Jack J3 should be connected to the power supply ground and Jack J5 should be connected as follows:

( ) Pins 1-4, and 13-16 +5V
( ) Pins 5, 6, 11, 12 +12V
( ) Pins 7, 10 -5V
( ) Pin 8, 9 +28V (optional used only for EPROM programming)

After you have connected jacks J3 and J5 to the power supply, check to be sure that the jacks are inserted properly (pin 1 to pin 1) and that you have the proper supply input on each pin. An error here is very costly - it will ruin the entire kit!

As a further precaution before applying continuous power, we suggest that you perform the following power supply check. Place your volt-ohmmeter on the pins shown below, turn power on and then immediately turn power back off again. While power is on, quickly check the reading and verify that it is correct. If it is not correct, then you have a construction error or you have not connected the power correctly.:orrect the problem before proceeding with final checkout.

(✓) +5V between Pin 16 of U8 and Pin 8 of U8
(✓) -5V between Pin 1 of U23 and Pin 8 of U8
(✓) +12V between Pin 27 of U23 and Pin 8 of U8

Turn off power and install the 9900 CPU. The socket was installed earler. Be certain to properly orient the CPU. Pin 1 should be in the corner nearest the toggle switches. Handle the CPU carefully since it can be easily damaged by careless handling.

Turn off the power. Connect your terminal to input jack J10. If you have an RS-232C terminal, the pins on its connector

( ) Pin 1 (terminal) to Pin 1 of J10
( ) Pin 2 to Pin 2 of J10
( ) Pin 3 to Pin 3 of J10
( ) Pin 5 to Pin 4 of J10
( ) Pin 6 to Pin 5 of J10
( ) Pin 8 to Pin 7 of J10
( ) Pin 7 to Pin 6 of J10

If you have a TTY or other 20ma current loop interface, connect it as follows (there are no standard connector assignments - refer to the manual for your terminal):

( ) TTY IN - INPUT to Pin 11 of J10 and return on Pin 10 of J10

( ) TTY OUT - input on Pin 8 of J10 and return on Pin 9 of J10

Apply power to the kit. If you are using a TTY, and it begins to "chatter" then reverse the output leads (Pin 8 and Pin 9).

To activate the monitor, reset the CPU and then type the letter 'X' on the terminal. The CPU should respond with a "?". If you cannot get the "?", you have an assembly error. First, check the small things:

( ) SW1 set correctly? (in LOAD position)
( ) SW2 oriented correctly? (handle toward CPU)
( ) Terminal wired correctly?
( ) All I.C's in right position?
( ) Monitor EPROM in proper socket? (If they are reversed the monitor won't work)
( ) All jumpers properly installed?

If the monitor responds with "?", then the kit is running. Try using the monitor and exploring the capabilities of your new computer. If you have further trouble and cannot get the kit running, contact the dealer that you purchased the kit from and ask for assistance.