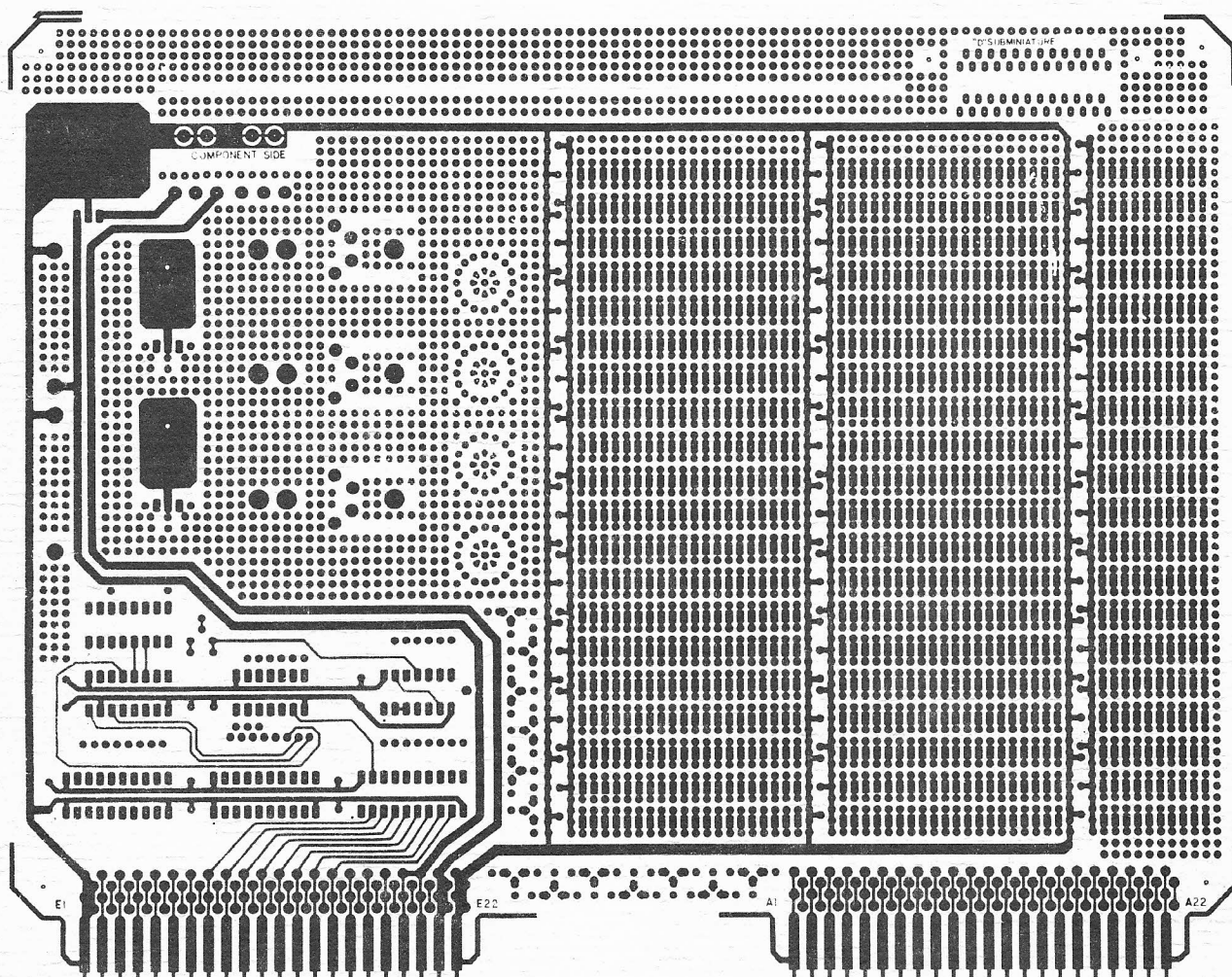


# PROTO PLUS II<sup>TM</sup>



FOR THE  
**AIM • SYM • KIM**

# **AIM — SYM — KIM OWNERS**

The **COMPUTERIST** specializes in expansion needs for your **AIM/SYM/KIM**. We offer a wide variety of support in expansion boards, power supplies, and software. Since we are continuously developing new 6502 based products, please contact us for the latest product and pricing information.

**WRITE FOR OUR CURRENT CATALOG**

The **COMPUTERIST, Inc.**  
34 Chelmsford St.  
Chelmsford, MA 01824  
617/256-3649

## PROTO PLUS II

### SOCKETS

20 pin - U1, 2, 3

16 pin - U4, sw1

14 pin - U5, 6

### IC's

LS95's - U1,2

LS245 - U3

LS156 - 04

LS32 - U5

LS04 - U6

8 position DIP switch - sw1

### CAPS

103m caps - C1, C2, C3, C4, C5

22 uf cap - C7

### RESISTORS

RED, RED, BROWN - R2

BROWN, BLUE, RED - R1

NOTE: Sockets and IC's must follow schematic layout (indent)  
They must all be facing towards left of P.C. board.  
Also: The number 103M on caps should face left of board.

# **PROTO PLUS II<sup>TM</sup>**

**Prototyping and Custom Circuit Board**

**for the**

**AIM ● SYM ● KIM**

**Universal Grid Pattern**

**Address and Data Buffering**

**8K Bank Address Decoding**

**On-Board Voltage Regulators**

**Patterns for Special Devices**

**The Computerist, Inc.  
34 Chelmsford Street  
Chelmsford, MA 01824**

**617/256-3649**

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**September 1980**

### **Limited Warranty and Service**

Should you experience difficulty with your **PROTO PLUS II** board and be unable to diagnose or correct the problem, you may return the board to The COMPUTERIST, Inc. for repair. **PROTO PLUS II** is warranted by The COMPUTERIST, Inc. against defects in workmanship and materials for a period of ninety [90] days from date of delivery. During the warranty period, The COMPUTERIST, Inc. will repair or, at its option, replace at no charge components that prove to be defective provided that the board is returned, shipping prepaid, to:

The COMPUTERIST, Inc.  
Service Department  
34 Chelmsford Street  
Chelmsford, MA 01824

The warranty does not apply if the board has been damaged by accident or misuse, or as a result of repairs or modifications made by other than authorized personnel at the above service facility. No other warranty is expressed or implied. The COMPUTERIST, Inc. is not liable for consequential damages.

Beyond the ninety [90] day warranty period, **PROTO PLUS II** boards will be repaired for a reasonable service fee. All service work performed by the COMPUTERIST, Inc. beyond the warranty period is warranted for an additional ninety [90] day period after shipment of the repaired board.

It is the customer's responsibility to return the board with shipping charges prepaid to the above service facility. For in-warranty service, the board will be returned to the customer, shipping prepaid, by the fastest economical carrier. For out-of-warranty service, the customer will pay for shipping charges both ways. The repaired board will be returned to the customer COD unless the repairs and shipping charges have been prepaid by the customer.

If you have any problems, please call us at 617/256-3649 and ask for "Service".



## Using the PROTO PLUS II

The primary purpose of this board is to provide a simple means to interface digital logic to an AIM, SYM, or KIM microcomputer. The board supports a wide variety of Integrated Circuit [IC] Dual Inline Package [DIP] configurations. It also provides patterns for various other components required by the typical logic board. The basic design philosophy is to have each plated through hole connected to at least one additional hole. This permits wires to be soldered or wire wrapped. For the purposes of this manual, the following board reference conventions apply: front is the side of the board with the silk screen, back is the unscreened side of the board, and top, bottom, left, right refer to the board when held so that the silk screen reads in the normal fashion.

**DIP Patterns:** The universal hole pattern permits any standard DIP package to be positioned on the grid. The major portion of the board provides space for DIP packages positioned horizontally. Standard .300 and .600 spaced devices will fit with their legs in the center holes of the three hole pad patterns. This leaves the outside hole uncovered and available for soldering. The holes are large enough to accept wire-wrap sockets.

**Other Patterns:** Patterns are provided for a number of other standard devices. These include a variety of transistor packages, slide switches, rotary switches, voltage regulators, RS232 connectors, most .10 spaced connectors, plus all two-wire components such as capacitors, resistors, etc. The silk screen shows examples of how some of these devices may be mounted. Also indicated are a number of interconnected pads which can be conveniently used to distribute a signal to multiple locations. Provision is made for decoupling capacitors between the +5 volt and ground runs. These are normally .01 Mfd, and patterns are provided for two different common sizes.

**Edge Connectors:** A pair of gold plated dual 44 pin edge connectors provide a standardized interface to the AIM, SYM, and KIM microcomputers. The positioning and purpose of the two connectors follows that of the host microcomputers.

The Expansion Connector, located at the bottom left edge of the board, is configured to follow the standard KIM-4 conventions. These connections are shown in the Connection Table as they relate to the AIM, SYM and KIM. The +5 volt, +8 volt and ground connections are etched as major runs on the board. If the user chooses **NOT** to follow the standard interconnection scheme, then care must be taken to change these important lines as required. The user is encouraged to follow the convention if at all possible. The Address, Data and Control signals are used by the on-board circuit area as per these conventions.

The Application Connector only has one connection. This is the KIM Decode Enable on pin A-K. It may be removed by cutting the etch located on the back of the board near pin A-K if you are using an AIM or SYM or if you are providing the Decode Enable through the Expansion Connector at pin E-16 or by some other means. The Connection Table details the AIM, SYM, and KIM uses of the Application Connector.

**Power:** The board is set up to provide easy access to the +5 volts and ground normally required by computer circuitry. Regulated +5 may be connected directly through pins E-21 and/or E-Y. Alternatively, unregulated voltage in the range of +8 to +12 volts may be connected at pins E-19 and/or E-20, and a 1 amp voltage regulator installed at **Q1**. A capacitor of approximately 22 Mfd at 25 volts should then be installed at **C8**. Selection between the +5 which is regulated off the board and the +5 regulated from the on-board regulator is made by installing a jumper directly above switch **SW1**. A wire between the fourth and fifth holes will select the +5 volts from off-board. A wire between the second and third holes will select the +5 volts derived from the unregulated +8 volts. A switch may be installed at **SW1** to permit easy switching. In any case, the +5 volts will be routed as the major etched run on the back of the board. Ground is routed as the major etch on the front of the board. Numerous pads are conveniently placed to allow access the +5 volts and ground throughout the board. Capacitors for decoupling ICs should be placed between the +5 volts and ground in the holes provided. Two common sizes of .01 Mfd capacitors will fit in the hole pattern.

## On-Board Circuitry

The Proto Plus II includes etched circuitry which can provide the support normally required to add any circuit to a 6502 based microcomputer. If you purchased the assembled/tested version of Proto Plus II, then all of the components have been added, burned in, and tested. If you purchased the bare board, then you will have to add the required components if you want to use the circuit. The circuit provides the following functions: address buffering, bi-directional data buffering, address decoding, control signal buffering, and, for the KIM-1, generation of the Decode Enable signal. The implementation of each function is described below.

**Address Buffering:** The drive capability of the AIM, SYM, or KIM is limited. Since the user circuitry on a Proto Plus II will usually require the address lines, these lines are buffered immediately upon coming onto the board. The IC used is an 81LS95 which is an eight line tri-state buffer. Two such chips provide buffering for the sixteen address lines. The buffered address signals are available at the pads located directly above the buffer chips and are marked to indicate the addressing pattern: **BA0** to **BA7** on the first chip, and, **BA8** to **BA15** on the second chip.

**Data Buffering:** Since many of the devices which may be added to the Proto Plus II are not inherently tri-stated, it is important that data be permitted to flow onto or off the board only when the board is selected by the microcomputer. This is accomplished by a 74LS245 bi-directional buffer with tri-state outputs. It is enabled only when the Proto Plus II is selected, during the last half of the Phase 2 period. The direction of the data transfer is determined by the buffered Read/Write line. This buffer chip also provides the extra drive which may be required by components added to the Proto Plus II board by the user.

**Address Decoding:** The Proto Plus II bi-directional data buffers will be enabled **ONLY** when addresses on the board are valid. This is determined by the address decoder. This is handled by a 74LS156, eight DIP switches, and two pull-up resistors. The 74LS156 uses the high three address lines, BA13 to BA15, to divide the 6502 memory space into eight 8K segments. The lowest segment (0000 to 1FFF) and the highest segment (E000 to FFFF) are normally used by the host. The remaining six 8K segments are readily available, unless other specific addresses are being used by the host or other peripheral boards. Any 8K segment may be enabled for the Proto Plus II by sliding the appropriate DIP switch into the **ON** position. The switches correspond to the memory addresses as shown in the table below:

Switch Number	Memory From	To	Used by
1	0000	1FFF	AIM, SYM, KIM Monitors and RAM
2	2000	3FFF	Normally Available
3	4000	5FFF	Normally Available
4	6000	7FFF	Normally Available
5	8000	9FFF	SYM Monitor ROM. Available on AIM/KIM
6	A000	BFFF	AIM and SYM I/O, RAM. Available on KIM
7	C000	DFFF	AIM and SYM BASIC. Available on KIM
8	E000	FFFF	Partially used by AIM, SYM, KIM monitors

[See your microcomputer users manual for specific details.]

Multiple 8K segments may be used on the Proto Plus II by simply putting each 8K select switch in the **ON** position. If only a portion of an 8K segment is to be used, then the user must provide additional address decoding on the Proto Plus II. This can be accomplished by cutting the etch between the pads at **J1**, taking the 8K address select from the bottom pad of **J1**, performing the additional address decoding, and returning the modified address select signal to the top pad of **J1**.

**Control Signal Buffering:** To ensure minimal loading of the 6502 control lines, the important control signals are buffered immediately upon arriving at the Proto Plus II. A 74LS04 is used to provide the following signals:

Read/Write      Read/Write      Phase 2      Phase 2

These signals are made available at pads clearly marked above the 74LS04 chip. A spare inverter gate is available and is marked **IN** for the input side and **OUT** for the inverted output.

**KIM-1 Decode Enable:** Since the KIM does not do a complete address decoding on-board, any peripheral board must have the ability to provide a signal to the KIM, called Decode Enable, whenever a KIM on-board location is addressed. This is done on Proto Plus II by a circuit which combines the lowest (0000 to 1FFF) and highest (E000 to FFFF) address selects from the address decoder circuit, and brings the signal out to pin A-K on the Application Connector. For compatibility with Mother Plus II and/or our standard cables, the KIM user may wish to run a wire from this decode circuitry to pin E-16. This will permit the Proto Plus II to run with our standard system components. This signal is required only by the KIM, and is **NOT** used by the AIM or SYM. For this reason, the signal is not pre-wired to E-16, leaving this pin open for other uses.

**Misc.:** 1. There are four OR gates on the 74LS32, only one of which is used for the address decoding/bi-directional data buffering circuit. The other three gates may be used and pads are provided. The user should consult his IC manual for the pinouts and uses of this IC chip.

2. An electrolytic capacitor is installed to provide noise suppression on the +5 volt input.



# Connection Table

Expansion Connector					Application Connector				
Computer					Computer				
PIN	AIM	SYM	KIM	Boards PROTO PLUS II	PIN	AIM	SYM	KIM	Boards PROTO PLUS II
1	SYNC	SYNC	SYNC	<b>GND</b>	1	GND	GND	GND	<b>NC</b>
2	RDY	RDY	RDY	<b>SYNC</b>	2	PA3	PA3	PA3	<b>NC</b>
3	$\phi 1$	$\phi 1$	$\phi 1$	<b>RDY</b>	3	PA2	PA2	PA2	<b>NC</b>
4	$\overline{IRQ}$	$\overline{IRQ}$	$\overline{IRQ}$	$\overline{IRQ}$	4	PA1	PA1	PA1	<b>NC</b>
5	S.O.	S.O.	S.O.	S.O.	5	PA4	PA4	PA4	<b>NC</b>
6	$\overline{NMI}$	$\overline{NMI}$	$\overline{NMI}$	$\overline{NMI}$	6	PA5	PA5	PA5	<b>NC</b>
7	$\overline{RES}$	$\overline{RES}$	$\overline{RES}$	$\overline{RES}$	7	PA6	PA6	PA6	<b>NC</b>
8	DB7	DB7	DB7	DB7	8	PA7	PA7	PA7	<b>NC</b>
9	DB6	DB6	DB6	DB6	9	PB0	PB0	PB0	<b>NC</b>
10	DB5	DB5	DB5	DB5	10	PB1	PB1	PB1	<b>NC</b>
11	DB4	DB4	DB4	DB4	11	PB2	PB2	PB2	<b>NC</b>
12	DB3	DB3	DB3	DB3	12	PB3	PB3	PB3	<b>NC</b>
13	DB2	DB2	DB2	DB2	13	PB4	PB4	PB4	<b>NC</b>
14	DB1	DB1	DB1	DB1	14	PA0	PA0	PA0	<b>NC</b>
15	DB0	DB0	DB0	DB0	15	PB7	PB7	PB7	<b>NC</b>
16	-12V	<b>CS18</b>	K6	<b>NC</b>	16	PB5	PB5	PB5	<b>NC</b>
17	+12V	<b>DBOUT</b>	<b>SSTOUT</b>	<b>NC</b>	17	<b>PB6</b>	<b>Row 0</b>	<b>Row 0</b>	<b>NC</b>
18	$\overline{CS8}$	$\overline{POR}$	<b>NC</b>	<b>DMA</b>	18	<b>CB1</b>	<b>Col F</b>	<b>Col F</b>	<b>NC</b>
19	$\overline{CS9}$	<b>NC</b>	<b>NC</b>	+8V	19	<b>CB2</b>	<b>Col B</b>	<b>Col B</b>	<b>NC</b>
20	$\overline{CSA}$	<b>NC</b>	<b>NC</b>	+8V	20	<b>CA1</b>	<b>Col E</b>	<b>Col E</b>	<b>NC</b>
21	+5V	+5V	+5V	+5V	21	<b>CA2</b>	<b>Col A</b>	<b>Col A</b>	<b>NC</b>
22	GND	GND	GND	GND	22	<b>NC</b>	<b>Col D</b>	<b>Col D</b>	<b>NC</b>
A	AB0	AB0	AB0	<b>GND</b>	A	+5V	+5V	+5V	<b>NC</b>
B	AB1	AB1	AB1	<b>AB0</b>	B	<b>NC</b>	$\overline{CS 00}$	K0	<b>NC</b>
C	AB2	AB2	AB2	<b>AB1</b>	C	$\phi 2$	$\overline{CS 04}$	K1	<b>NC</b>
D	AB3	AB3	AB3	<b>AB2</b>	D	R/W	$\overline{CS 08}$	K2	<b>NC</b>
E	AB4	AB4	AB4	<b>AB3</b>	E	Tape 1B-R	$\overline{CS 0C}$	K3	<b>NC</b>
F	AB5	AB5	AB5	<b>AB4</b>	F	Tape 1B	$\overline{CS 10}$	K4	<b>NC</b>
H	AB6	AB6	AB6	<b>AB5</b>	H	Tape 2B-R	$\overline{CS 14}$	K5	<b>NC</b>
J	AB7	AB7	AB7	<b>AB6</b>	J	Tape 2B	$\overline{CS 1C}$	K7	<b>NC</b>
K	AB8	AB8	AB8	<b>AB7</b>	K	<b>NC</b>	$\overline{CS 18}$	<b>Decode</b>	<b>Decode</b>
L	AB9	AB9	AB9	<b>AB8</b>	L	Audio In	Audio In	Audio In	<b>NC</b>
M	AB10	AB10	AB10	<b>AB9</b>	M	Audio Lo	Audio Lo	Audio Lo	<b>NC</b>
N	AB11	AB11	AB11	<b>AB10</b>	N	+12V	<b>RCN-1</b>	+12V	<b>NC</b>
P	AB12	AB12	AB12	<b>AB11</b>	P	Audio Hi	Audio Hi	Audio Hi	<b>NC</b>
R	AB13	AB13	AB13	<b>AB12</b>	R	KBD Rtn	KBD Rtn	KBD Rtn	<b>NC</b>
S	AB14	AB14	AB14	<b>AB13</b>	S	PTR Rtn	PTR Rtn	PTR Rtn	<b>NC</b>
T	AB15	AB15	AB15	<b>AB14</b>	T	KBRD	KBRD	KBRD	<b>NC</b>
U	$\phi 2$	$\phi 2$	$\phi 2$	<b>AB15</b>	U	PTR	PTR	PTR	<b>NC</b>
V	R/W	R/W	R/W	$\phi 2$	V	Tape 2A	<b>Row 3</b>	<b>Row 3</b>	<b>NC</b>
W	$\overline{R/W}$	$\overline{R/W}$	$\overline{R/W}$	R/W	W	Tape 1A	<b>Col G</b>	<b>Col G</b>	<b>NC</b>
X	TEST	TEST	TEST	$\phi 2$	X	<b>NC</b>	<b>Row 2</b>	<b>Row 2</b>	<b>NC</b>
Y	$\phi 2$	$\phi 2$	$\phi 2$	+5V	Y	Serial In	<b>Col C</b>	<b>Col C</b>	<b>NC</b>
Z	Ram R/W	Ram R/W	Ram R/W	<b>GND</b>	Z	<b>NC</b>	<b>Row 1</b>	<b>Row 1</b>	<b>NC</b>

Notes: Signals which are the same are in regular type face.  
Signals which are different are in **bold** type face.

See your computer manual for a definition of the signals.

The **PROTO PLUS II** bus is identical to the **KIM-4** bus.

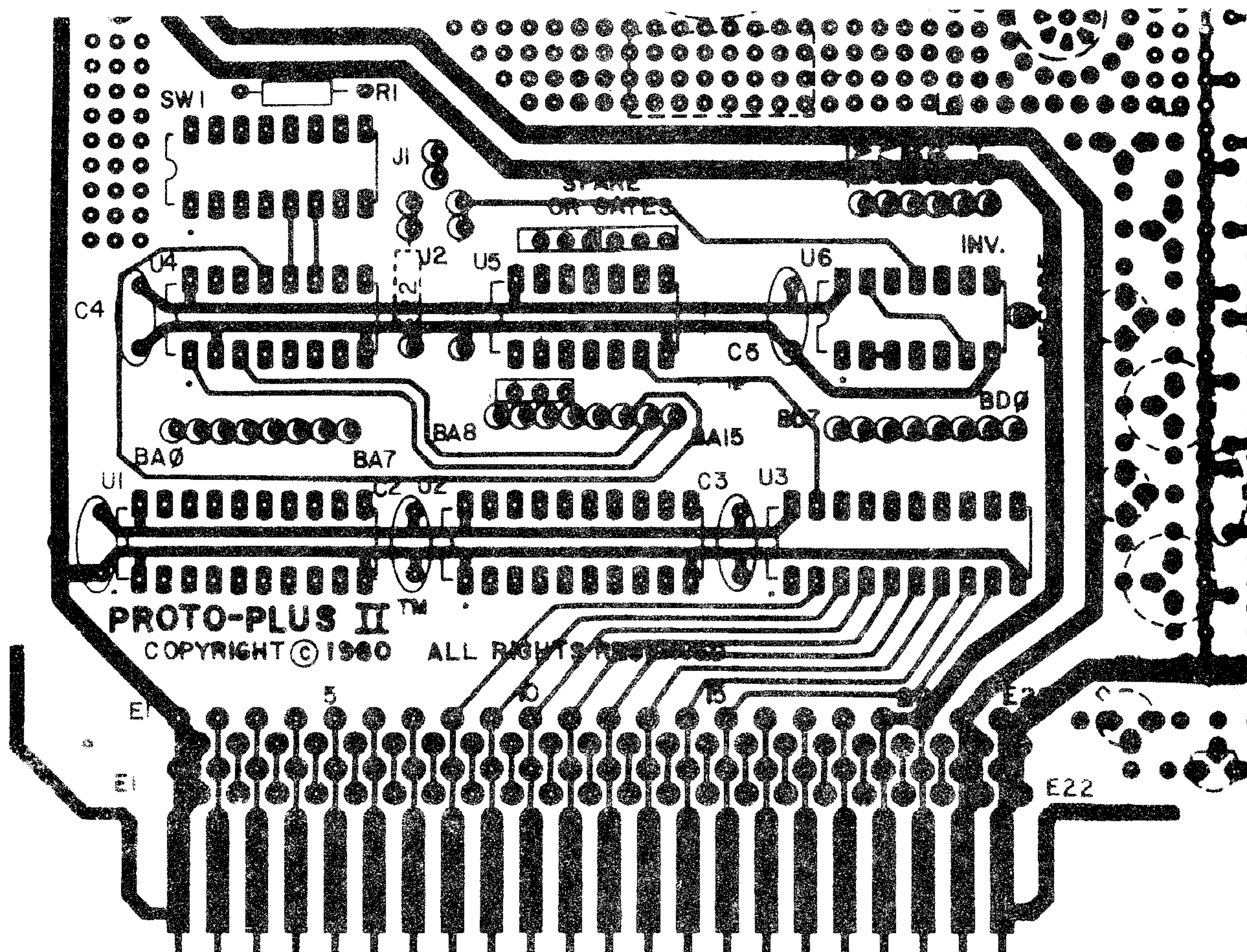
Notes: The connections for the application connector are not defined for the **PROTO PLUS II** bus, with the exception of the Decode signal for the KIM-1 on A-K. The application connections are defined by the specific requirements of the expansion board and are generally **not** connected to the host computer.

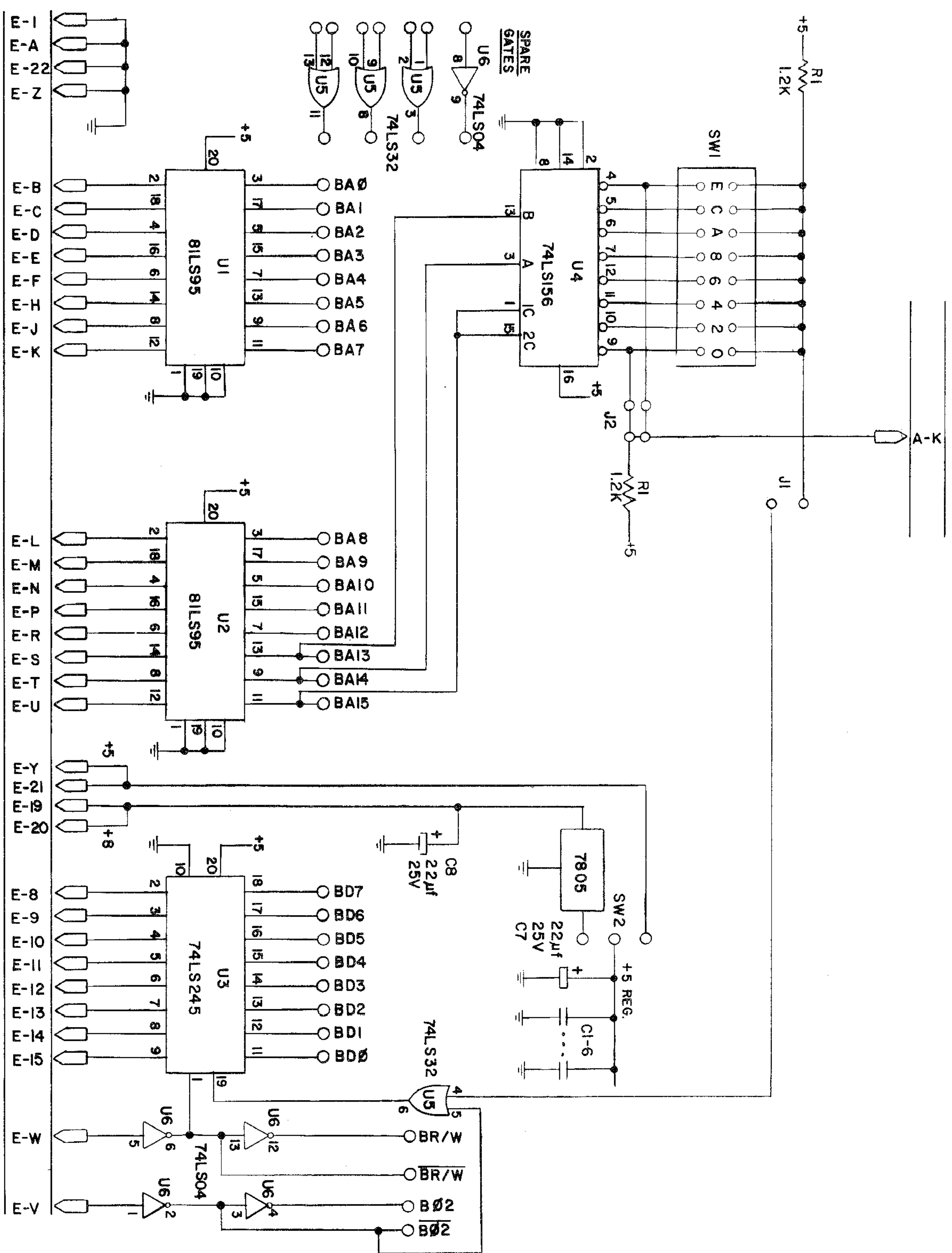


## Parts List

Item	Part Number	Qty.	Description
<b>Integrated Circuits</b>			
1.	U1, U2	2	81LS95 Octal Tri-State Buffers
2.	U3	1	74LS245 Octal Bi-directional Tri-State Buffers
3.	U4	1	74LS156 3 to 8 Decoder with Open Collector Outputs
4.	U5	1	74LS32 Quad OR Gates
5.	U6	1	74LS04 Hex Inverters
<b>Resistors and Capacitors</b>			
6.	R1, R2	2	1.2K ohm 1/4 watt
7.	C1-C6	6	.01 Mfd Decoupling Capacitors
8.	C7,[C8]	1,[1]	22 Mfd 25V Electrolytic Capacitor
<b>Miscellaneous</b>			
9.	S1-S3	3	20 pin socket
10.	S4, SSW1	2	16 pin socket
11.	S5, S6	2	14 pin socket
12.	SW1	1	8 position DIP switch
13.		[1]	[7805 +5 volt regulator]

Note: Since some of the parts on the Proto Plus II board do not have critical values, substitutions, changes and discrepancies may be found between this list and the actual board. None of the variations will in any way affect the operation of the board.





UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES: FRACTIONS ± 1/64  
ANGLES ± 1/2°  
HOLE DIA. ± 0.015  
HOLE DIA. ± 0.015  
HOLE DIA. ± 0.015

DATE  
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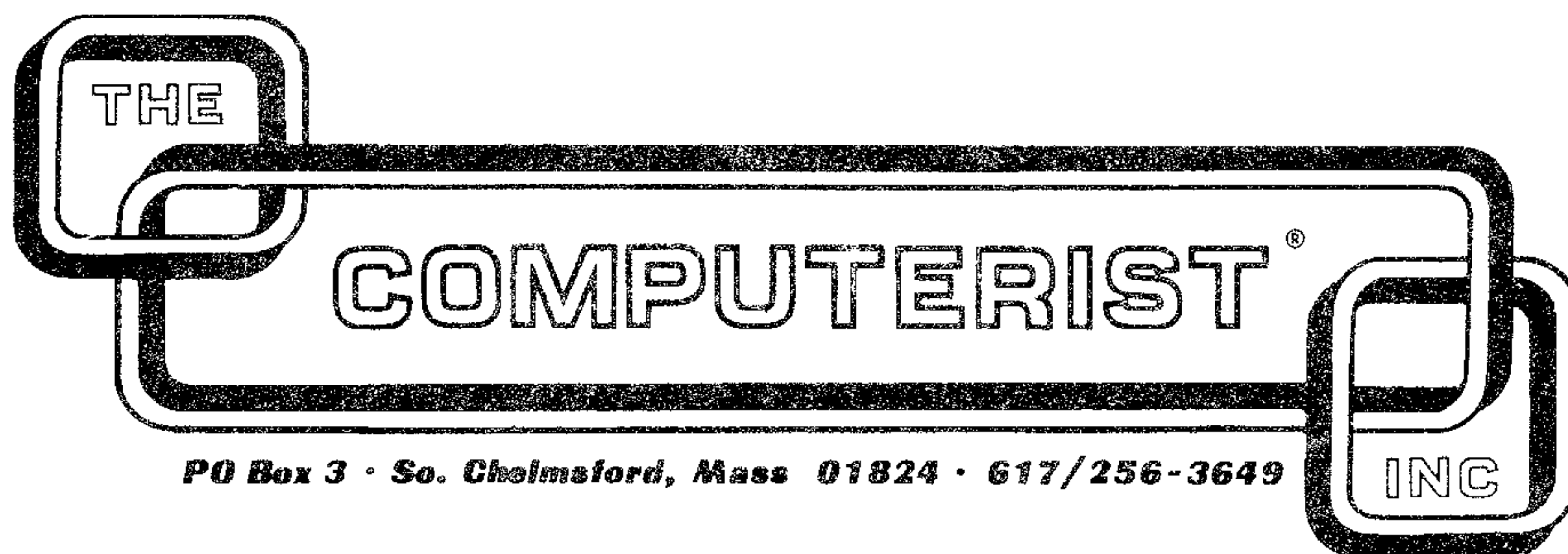
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THE COMPUTERIST INC.  
SCHEMATIC  
PROTO-PLUS II™

SIZE CODE IDENT NO. DWG NO. REV

SCALE 1:1 SHEET





### PROTO PLUS<sup>tm</sup> Instructions

PROTO PLUS is designed to make it easy for you to add your own circuitry to a KIM, SYM, or AIM system. It is the same size and shape as the KIM or SYM and can be easily mounted beneath them. The two sets of connector fingers are the same configuration as found on the AIM, SYM, or KIM. Some of the important features of PROTO PLUS are:

1. Two-sided board with plated through holes and gold plated fingers.
2. IC pattern is set so that either wire wrap or solder sockets may be used. If solder sockets are used, then the double pads next to each socket pin are used for the soldered wire interconnections.
3. There is room for up to 40 14/16 pin sockets:
  - 9 in the upper left corner
  - 6 near the right edge
  - 25 in the main section in the middle of the board
4. There is room for 4 24/40 pin sockets in the lower left corner.
5. Space and interconnections for 3 voltage regulators is provided along the left edge of the board with large heat pads.
6. Two sets of interconnection busses are provided to make multiple bus type connections easy:
  - 8 bus lines near the connectors
  - 16 bus lines near the top center of the board
7. There are pads for the placement of bypass capacitors near the ICs.
8. Other types of components - diodes, resistors, etc. - can be placed in the general purpose areas at the upper right and lower right sections of the board.
9. The four corner mounting holes are positioned to match those on the KIM or SYM so that you can mount the PROTO PLUS directly underneath your KIM or SYM on stand-offs making a neat, convenient package.





Dear Proto Plus Customer:

As shown in the attached table, we have enhanced our Proto Plus product. The new board is available in unassembled or assembled form at \$45.00 or \$60.00 respectively.

To fill your order we have shipped the unassembled version of Proto Plus II. Detailed documentation will automatically be mailed when available from the printers in two weeks.

We appreciate your business and solicit your comments on the use and application of this or any other Computerist product.

Very truly yours,

James Anderson  
Director, Sales  
and Marketing

JA/kjw

Attachment: Proto Plus: Proto Plus II Comparision Table

PRODUCTS ENHANCEMENTS: PROTO PLUS II

FEATURE	PRODUCTS	
	PROTO PLUS	PROTO PLUS II
Proto Pattern	Limited	Universal
All holes on .1 grid	No	Yes
Improved Etched pattern for		
Rotary Switches	No	Yes
Transistors	No	Yes
Silk Screen	No	Yes
Etched pattern for basic circuitry		
Address Decoding/ selection for 8K boundary	No	Yes
Address line Buffering	No	Yes
Bi-directional Tri-State Data Line Buffers	No	Yes

August 1980

Proto Plus: Proto Plus II Comparision Table