DIGITAL RESEARCH COMPUTERS

(214) 225-2309

## INTRODUCTION

The 128K S-100 Static Ram/Eprom Board you have just purchased is one of the best Ram/Eprom bargains on the market today. We have gone to great lengths to combine the right mix of features that are most often required on high density Ram/Eprom boards for S-100(IEEE-696) systems.

## FEATURES:

FULL STATIC OPERATION!

FULL S-100 IEEE-696 COMPATIBLE!

USES POPULAR 28 PIN "2764" STYLE 8K X 8 DEVICES

EACH LOCATION MAY BE DISABLED

16 BIT AUTOMATIC MODE (8 OR 16 BIT OPERATION)

8 BIT SEQUENTIAL MODE (8 BIT ONLY OPERATION)

ZERO TO SEVEN WAIT STATES

BYTE LOW OR BYTE HIGH MODE

24 BIT EXTENDED ADDRESSING BUT WILL WORK IN OLDER 8 BIT SYSTEMS

FRONT PANEL OPERATION

FAST ACCESS TIMES (50NS PLUS MEMORY ACCESS TIME)

PC BOARD IS SOLDER MASKED AND SILK SCREENED

GOLD PLATED CONTACT FINGERS FOR LONG LIFE

ALL DATA, ADDRESS AND CONTROL LINES FULLY BUFFERED

PHANTOM AVAILABLE

LOW POWER OPERATION (<600 MA. TYP.)

PARTS LIST:

| | |
|---|---|
| 7 | 14 PIN SOCKETS |
| 7 | 16 PIN SOCKETS |
| 11 | 20 PIN SOCKETS |
| 16 | 28 PIN SOCKETS |
| 16 | SHORTING BLOCKS |
| 16 | 3 PIN JUMPER POST |
| 2 | HEATSINKS (THM 6106-14) WITH #6 HARDWARE |
| 28 | .1 MFD BYPASS CAPS (VALUE MAY VARY) |
| 4 | 1 MFD 16 VOLT OR GREATER TANTALUM CAPACITORS |
| 5 | 2.2K TO 5.6K 10 PIN RESISTOR PACKS(PIN 1 COMMON) |
| 1 | 220 OHM 1/4 WATT RESISTOR |
| 1 | 2.2K TO 5.6K 1/4 WATT RESISTOR |
| 2 | 7805 VOLTAGE REGULATOR |
| 1 | 74LS00 |
| 1 | 7406 |
| 1 | 74LS10 |
| 1 | 74LS14 |
| 2 | 74LS30 |
| 1 | 74LS86 |
| 2 | 74LS138 |
| 4 | 74LS157 |
| 1 | 74LS165 |
| 9 | 74LS244 |
| 1 | PAL 16L8 |
| 1 | 25LS2521 |
| 4 | 8 POSITION DIP SWITCHES |
| 1 | LED |

## GENERAL CONSTRUCTION HINTS

For soldering we recomend a 32 watt soldering pencil. Do not use a soldering gun!!! Use a quality grade small diameter (such as 22 gauge) rosin core 60/40 alloy solder.

Keep the soldering pencil clean with a wet sponge or cloth.

After soldering such components as resistors or capacitors, use a small pair of diagonal cutters to remove the excess lead length.

Observe polarities on all tantalum caps, resistor packs, ICs and LEDs.

If any discrepancies between the parts received and those listed are noticed please notify us.

## LIMITED WARRANTY

Read the enclosed yellow sheet for a statement of our limited warranty as relates to this kit.

Also note that when this product is purchased as a blank board, all that is covered by the limited warranty is the PC Board itself.

ASSEMBLY INSTRUCTIONS

[] Give the PC Board a good visual inspection for any obvious shorts or opens. There should be none, but a few minutes spent here could save hours later.

[] Using an Ohmmeter, insure that there are no shorts between buss pins 1 and 50.

[] Install and solder the 28 pin sockets for IC locations Y1 through Y8 and X1 through X8. Note that pin #1 on all ICs is oriented to the top of the board.

[] Install and solder the 11 20 pin sockets at locations U11-U15, U20, U23 and U26-U29.

[] Install and solder the 7 16 pin sockets at locations U3, U5, U8, U21-U22 and U24-U25.

[] Install and solder the 7 14 pin sockets at locations U1, U6, U9-U10, U16 and U30-U31.

[] Install and solder the 4 8-position dip switches at locations S1-S4.

[] Install and solder 4 resistor packs at locations U2, U4, U7 and U19. NOTE PIN #1 IS TOWARDS THE TOP OF THE BOARD.

[] Install and solder the remaining resistor pack in location U32. NOTE PIN #1 IS TOWARDS THE LEFT EDGE OF THE BOARD, DENOTED BY THE DOT.

[] Install and solder the 16 3-pin jumper posts near locations Y1-Y8 and X1-X8 labeled ROMRAM.

[] Install and solder the bypass caps in locations C1-C23 and C28-C32.

[] Install and solder the 2.2K to 5.6K OHM resistor at location R1.

[] Install and solder the 220 OHM resistor in location R2.

[] Install and solder the LED at location DS1. The cathode (denoted by the flat side) goes towards the bottom of the board.

[] Install and solder the 4 Tantalum caps at locations C24-C27. Please observe the proper polarity when installing the parts.

[] Using the heatsinks and hardware, install and solder the 2 7805 voltage regulators at locations U17-U18.

[] Using any of the regulator mounting tabs as ground, measure the output of each 7805 under power in your system. The output is

measured on the right most pin of the 7805. The measured voltage should be between 4.75 and 5.25 VDC. Any regulator out of spec. must be replaced.

[] Install a 74LS00 in socket location U30. Pin #1 is to the top.

[] Install a 7406 in location U10.

[] Install a 74LS10 in location U31.

[] Install a 74LS14 in location U16.

[] Install two 74LS30s in locations U1 and U6.

[] Install a 74LS86 in location U9.

[] Install two 74LS138s in locations U3 and U8.

[] Install four 74LS157s in locations U21-U22 and U24-U25.

[] Install a 74LS165 in location U5.

[] Install nine 74LS244s in locations U11-U14, U23 and U26-U29.

[] Install a PAL 16L8 in location U15.

[] Install a 25LS2521 in location U20.

[] Remeasure the voltage outputs on the 7805s now to insure proper operation.

[] Install shorting blocks in ROMRAM locations as per your application. See Setup and Use for information.

## SETUP AND USE

Determine which locations you need to be RAM and which need to be EPROM. Using the shorting blocks provided jumper the center pin at each location to either RAM (right pin) or ROM (left pin).

Switches S1 and S3 enable memory locations when the switch is on. The location is disabled when the switch is off.

16 BIT MODE

SWITCH S1(first byte)

| POSITION | MEMORY LOCATION |
|---|---|
| 1(Y1) | 00000-03FFF |
| 2(Y2) | 04000-07FFF |
| 3(Y3) | 08000-0BFFF |
| 4(Y4) | 0C000-0FFFF |
| 5(Y5) | 10000-13FFF |
| 6(Y6) | 14000-17FFF |
| 7(Y7) | 18000-1BFFF |
| 8(Y8) | 1C000-1FFFF |

SWITCH S3(second byte)

| POSITION | MEMORY LOCATION |
|---|---|
| 1(X1) | 00000-03FFF |
| 2(X2) | 04000-07FFF |
| 3(X3) | 08000-0BFFF |
| 4(X4) | 0C000-0FFFF |
| 5(X5) | 10000-13FFF |
| 6(X6) | 14000-17FFF |
| 7(X7) | 18000-1BFFF |
| 8(X8) | 1C000-1FFFF |

8-BIT MODE

SWITCH S1

| POSITION | MEMORY LOCATION |
|---|---|
| 1(Y1) | 00000-01FFF |
| 2(Y2) | 04000-05FFF |
| 3(Y3) | 08000-09FFF |
| 4(Y4) | 0C000-0DFFF |
| 5(Y5) | 10000-11FFF |
| 6(Y6) | 14000-15FFF |
| 7(Y7) | 18000-19FFF |
| 8(Y8) | 1C000-1DFFF |

SWITCH S3

| POSTION | MEMORY LOCATION |
|---|---|
| 1(X1) | 02000-03FFF |
| 2(X2) | 06000-07FFF |
| 3(X3) | 0A000-0BFFF |
| 4(X4) | 0E000-0FFFF |
| 5(X5) | 12000-13FFF |
| 6(X6) | 16000-17FFF |
| 7(X7) | 1A000-1BFFF |
| 8(X8) | 1E000-1FFFF |

Switch S2 positions 1 through 7 enable wait states. Zero wait states are all positions off. One wait state is position 1 on. Two wait states are positions 1 and 2 on. Three wait states are positions 1, 2 and 3 on. And so on till seven wait states are positions 1 to 7 all on.

Switch S2 position 7 reverses the order in which 8 bit bytes are transfered during a double byte transfer(16 bit mode without STXRQ). Normally this switch is on.

Switch S4 position 1 is the MODE switch. Off is 16 BIT MODE, ON is 8 BIT (only) MODE.

Switch S4 positions 2 through 8 correspond to address bits A23 through A17 respectively. OFF equals a high bit and ON equals a low bit.

NOTES ON OLD 8 BIT SYSTEMS

This board will work in older systems such as an IMSAI or ALTAIR. To do so requires some unique switch settings and memory chip placement. Remember that these are 64k systems so only 1/2 of the board will be used. Install memory devices in locations Y5-Y8 and X5-X8.

SWITCH S1

| POSITION | SETTING | EXPLAINATION |
|---|---|---|
| 1(Y1) | OFF | NOT USED |
| 2(Y2) | OFF | NOT USED |
| 3(Y3) | OFF | NOT USED |
| 4(Y4) | OFF | NOT USED |
| 5(Y5) | ON | 0000-1FFF |
| 6(Y6) | ON | 4000-5FFF |
| 7(Y7) | ON | 8000-9FFF |
| 8(Y8) | ON | C000-DFFF |

SWITCH S3

| POSITION | SETTING | EXPLAINATION |
|---|---|---|
| 1(X1) | OFF | NOT USED |
| 2(X2) | OFF | NOT USED |
| 3(X3) | OFF | NOT USED |
| 4(X4) | OFF | NOT USED |
| 5(X5) | ON | 2000-3FFF |
| 6(X6) | ON | 6000-7FFF |
| 7(X7) | ON | A000-BFFF |
| 8(X8) | ON | E000-FFFF |

SWITCH S2

| POSITION | SETTING | EXPLAINATION |
|---|---|---|
| 1 | OFF | NEW CHIPS PLENTY FAST ENOUGH |
| 2 | OFF | " |
| 3 | OFF | " |
| 4 | OFF | " |
| 5 | OFF | " |
| 6 | OFF | " |
| 7 | OFF | " |
| 8 | ON | NORMAL POSITION |

SWITCH S4

| POSITION | SETTING | EXPLAINATION |
|---|---|---|
| 1 | ON | 8 BIT (only) MODE |
| 2 | OFF | NO EXTENDED ADDRESS LINES ON BUSS |
| 3 | OFF | BUSS LINES PULLED UP ON BOARD |
| 4 | OFF | TO HIGH STATE BY RESISTOR PACK |
| 5 | OFF | " |
| 6 | OFF | " |
| 7 | OFF | " |
| 8 | OFF | " |

Of course if your system uses extended addressing then this section does not apply, you must use the first section.

## THEORY OF OPERATION

Lower order address lines are buffered by U23 and U26. After passing through the 74LS157 multiplexers U21, U22, U24 and U25, they enter the memory chips. The multiplexers are controlled by S4 position 1. When on the memory chips see the normal address lines. This is the normal 8 bit method. When off they see address lines shifted by one, i.e. Buss line A1 goes to memory chip A0. This is the normal 16 bit method.

The output of U21 Pin 12 may be inverted by U9 and Switch S2 position 8 in order to reverse the order of the double fetch done when making 8 bit transfers in the 16 bit mode.

A14 through A16 are buffered by U11 and decoded by U3 and U8 to provide chip selects for the memory chips.

A17 through A23 are compared with Switch S4 positions 2 through 8 by U20 to generate a board select.

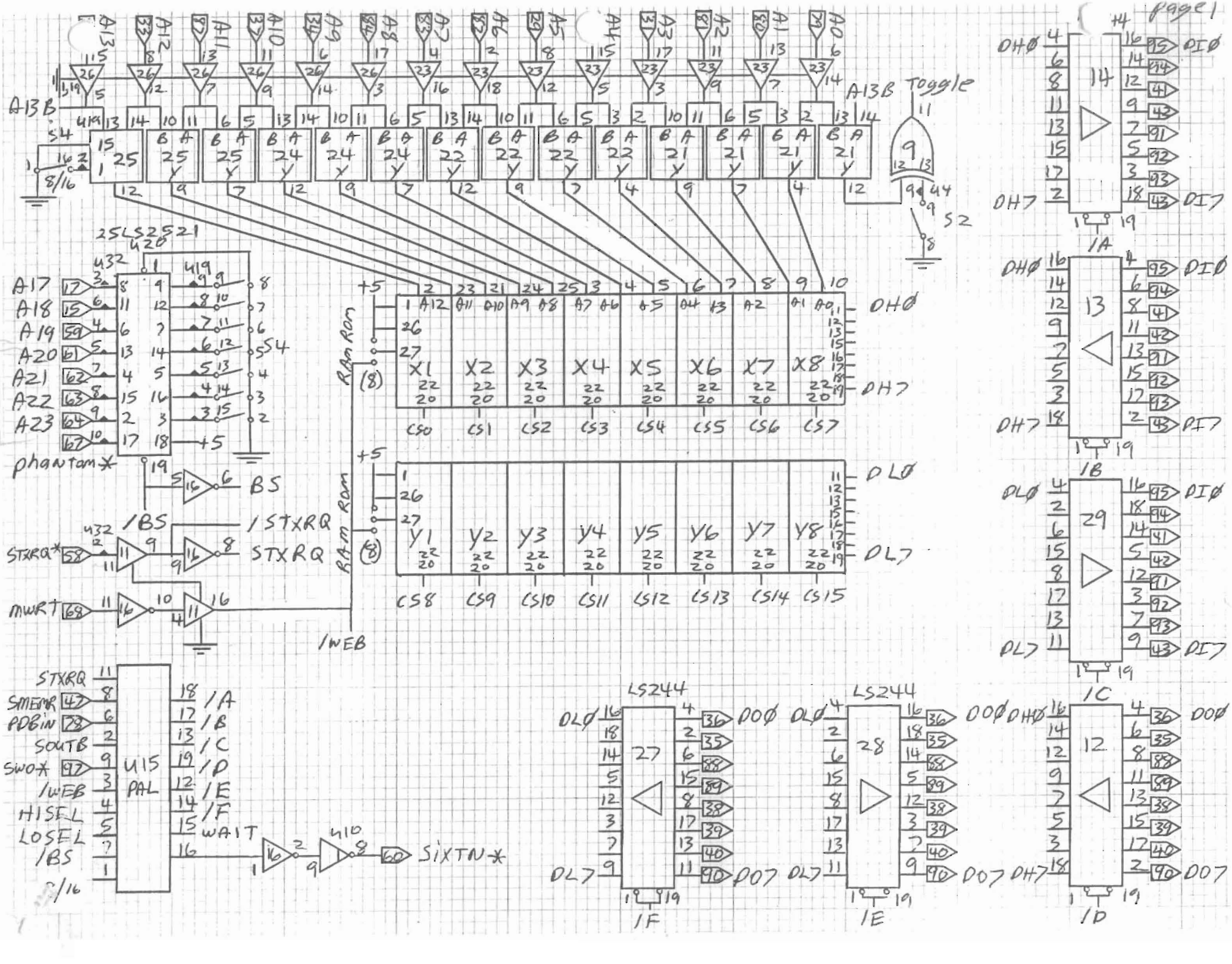
Phantom is also an input to U20.

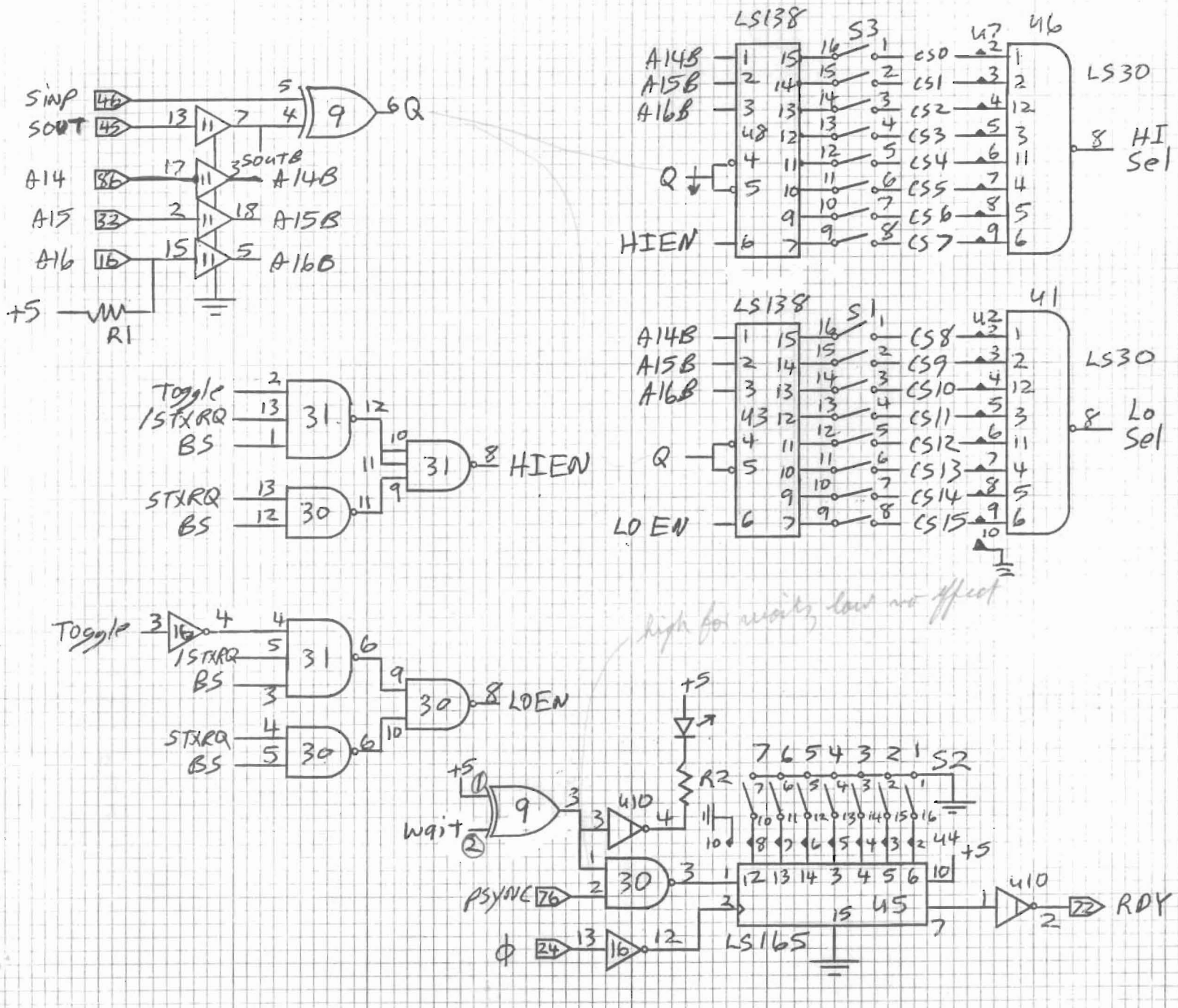
U15 is a 16L8 PAL and is used to generate enables for the data buffers (U12, U13, U14, U27, U28 and U29). It also enables the wait state generator and provides SIXTN*. While the enables meet the IEEE standard, the internal code of the PAL is proprietary.

U9 pins 4, 5 and 6 inhibit operation during I/O operations.

U30 and U31 provide seperate enables during 8 bit transfers and provide simultaneous enables during 16 bit transfers.

U1 and U6 provide signals to the PAL that a valid chip select has taken place so buffers may be enabled.


A13 A12 A11 A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0
A13B
Toggle
S4
8/16
S2
25LS525 21
U32
A17 A18 A19 A20 A21 A22 A23
phantom*
+5
RAM ROM
X1 X2 X3 X4 X5 X6 X7 X8
CS0 CS1 CS2 CS3 CS4 CS5 CS6 CS7
OH0 OH7
Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8
CS8 CS9 CS10 CS11 CS12 CS13 CS14 CS15
OL0 OL7
/BS
/STXRQ
STXRQ*
STXRQ
MWRT
/WEB
U15 PAL
STXRQ SMEMR PDBIN SOUTB SWO* /WEB HISEL LOSEL /BS
/A /B /C /D /E /F WAIT
U10
SIXTN*
LS244
OL0 OL7 OD0 OD7
/F /E /D /C
OH0 OH7 OD0 OD7
/A /B
OH0 OH7 OI0 OI7
OL0 OL7 OI0 OI7


SINP
SOUT
A14
A15
A16
+5
R1
SOUTB
A14B
A15B
A16B
Q
LS138
S3
U7
U6
LS30
HI Sel
HIEN
S1
U1
Lo Sel
LOEN
Toggle
1STXRQ
BS
STXRQ
HIEN
Wait
PSYNC
ϕ
R2
S2
U10
U4
LS165
RDY