MODEL RAM16 16K Static
RAM INSTRUCTIONS

The RAM16 is an S100 compatible 16,384 x 8 static
memory board.  It features:

* 250 or 450 nanosecond versions.

* Addressable in 4K steps by easily accessible
  DIP switch.

* Memory protection in 1K increments defined by
  an easily accessible DIP switch.  Protection
  may be from the bottom board address up or
  from the top down.

* Memory protection activated/deactivated by a
  large, easily accessed switch.

* May deactivate up to six 1K segments of the
  board to create "holes" for other devices.
  Accomplished with jumpers.

* Wait states selected by DIP switch.

* SOL Phantom line DIP Switch.

* 8 bank select lines provided for expansion
  into ½ million byte systems.

* All data, address, and control lines input buffered.

* Ignores I/0 commands at board address.

* Assembled, tested, and burned-in at factory.

* 1.3 A typical current consumption.

## INSTALLATION & OPERATION

Prior to installing the RAM16 into an S100 **chassis, power**

must be removed from the bus.  Note that this precaution should be
followed for any card on the S100 bus due to the close prox-
imity of various power signals on the bus.

The only other operating instructions involve setting
up the switches as described in the following paragraphs.
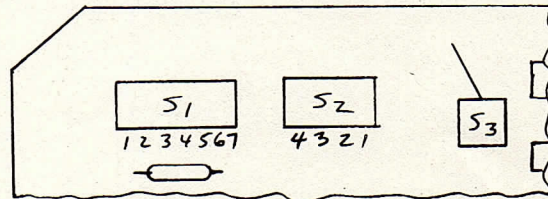

SWITCHES

The RAM16 is supplied with two DIP Switches.  When set-
ting these switches, it is recommended that a pencil or other
small pointed object be used to push the switch lever, thus
ensuring that the switch lever is firmly snapped into position.
A relatively small amount of positional offset could cause the
switch to be off when it should be on.

In the following tables  of switch settings, a "one"
means that the bottom of the switch is pushed in toward the
board (it also means that the top of the switch is protruding).
An example:



pushed in

0    Represents 1001
1

pushed in
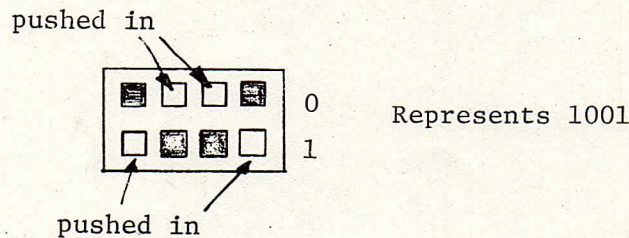
NOTE:  (Some switches are marked ON/OFF; ON corresponds to a
logic 0 and OFF to a logic 1.)

The top left switch is labeled S1 and controls board
address (4K steps), wait states (0, 1, or 2) and phantom line
selection.  S2 is to the right of S1 and selects the memory
protection boundary address.  S3 is a single large switch which
activates the memory protect feature.



ADDRESSING

Address selection is accomplished using switch S1, po-
sitions 1 thru 4.  The board address can be placed on any 4K
boundary:

|              | Switch 1 |
|--------------|----------|
| Addressing   | 1 2 3 4  |
| 0-3FFF       | 0 0 0 0  |
| 1000-4FFF    | 0 0 0 1  |
| 2000-5FFF    | 0 0 1 0  |
| 3000-6FFF    | 0 0 1 1  |
| 4000-7FFF    | 0 1 0 0  |
| 5000-8FFF    | 0 1 0 1  |
| 6000-9FFF    | 0 1 1 0  |
| 7000-AFFF    | 0 1 1 1  |
| 8000-BFFF    | 1 0 0 0  |
| 9000-CFFF    | 1 0 0 1  |
| A000-DFFF    | 1 0 1 0  |
| B000-EFFF    | 1 0 1 1  |
| C000-FFFF    | 1 1 0 0  |
| D000-0FFF    | 1 1 0 1  |
| E000-1FFF    | 1 1 1 0  |
| F000-2FFF    | 1 1 1 1  |

## MEMORY PROTECT

Memory protection is controlled by switches 2 and 3.  Switch 2 is a four position switch, which represents the protection boundary address relative to the board address.  Switch 3 enables or disables the total protect function.  When S3 is on, data will be protected up to and including the boundary 1K bank. Protection occurs in 1K steps:

|              | Addresses relative to Board Address | | |
|--------------|-----------|------------|-----------|
| Switch 2     |           |            | Amount    |
| Pos. 4 3 2 1 | Protected | Unprotected | Protected |
| 0 0 0 0      | 0-3FF     | 400-3FFF   | 1K        |
| 0 0 0 1      | 0-7FF     | 800-3FFF   | 2K        |
| 0 0 1 0      | 0-BFF     | C00-3FFF   | 3K        |
| 0 0 1 1      | 0-FFF     | 1000-3FFF  | 4K        |
| 0 1 0 0      | 0-13FF    | 1400-3FFF  | 5K        |
| 0 1 0 1      | 0-17FF    | 1800-3FFF  | 6K        |
| 0 1 1 0      | 0-1BFF    | 1C00-3FFF  | 7K        |
| 0 1 1 1      | 0-1FFF    | 2000-3FFF  | 8K        |
| 1 0 0 0      | 0-23FF    | 2400-3FFF  | 9K        |
| 1 0 0 1      | 0-27FF    | 2800-3FFF  | 10K       |
| 1 0 1 0      | 0-2BFF    | 2C00-3FFF  | 11K       |
| 1 0 1 1      | 0-2FFF    | 3000-3FFF  | 12K       |
| 1 1 0 0      | 0-33FF    | 3400-3FFF  | 13K       |
| 1 1 0 1      | 0-37FF    | 3800-3FFF  | 14K       |
| 1 1 1 0      | 0-3BFF    | 3C00-3FFF  | 15K       |
| 1 1 1 1      | 0-3FFF    | none       | 16K       |

NOTE:  An easy way to keep track of the protect address is to observe that switch 2, position 4, corresponds to A13, position 3 to A12, position 2 to A11, position 1 to A10.

Furthermore, A13 and A12 are the LSB's of the MSB hex address digit and ALL and A10 are the MSB's of the 2nd MSB hex address digit.  For example, if the switches are 1001, this corresponds to hex address 2400 (xx10 01xx xxxx xxxx).  Since all addresses with MSB's $\leq$ 2400 plus board address will be protected:

* protected data=board address
                    to board address + 27FF
* unprotected data=board address + 2800
                    to board address + 3FFF

A table at the end of this instruction manual shows all combinations of board addresses and protection.

A jumper option allows for the protection of data from the boundary address to the end of the 16K board address (ie. protection from the top down):

```
 IC15
 LS85
   3o   o1
   4o   o2
```
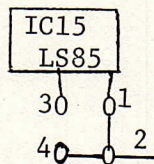
Break 1-2 and jump 3-4 for top down memory protection
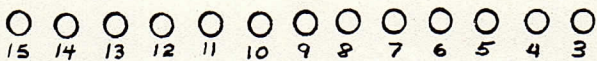
## SEGMENT DISABLE

Provision is made for the installation of up to six jumpers between memory addressing logic and board disable inputs. This disables sections of the memory so that the RAM16 board stays off of the S100 bus during computer access of the disabled section.  The six disable inputs may be  connected  to any of the 16 1K chip enables, or to address lines which allow for disabling 2K, 4K, or 8K segments.  To disable a 1K segment, a jumper should be  added from one of the pads labeled 0-15 to one of the 6 pads labeled segment disables.  For example, to disable segment 2:

```
    O O O O O O
  O   O  O   O      O O O
 A13  A13* A12* A11*    o  1  2
```

* *
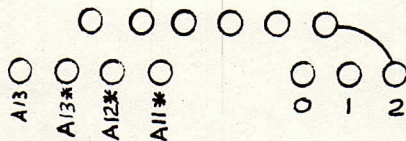
 Note that on some early boards the segment disables are incorrectly labeled 1-16 instead of 0-15.

```
 O  O  O  O  O  O  O  O  O  O  O  O
 15 14 13 12 11 10 9  8  7  6  5  4  3
```

Four more pads are provided for jumping All*, A12*, A13* or A13.

If one is not using all of the memory chips possible, then the ones to leave out are CS0 for segment 0, CS1 for segment 1, etc. as marked on the board. For example if one is disabling a segment at F800-FBFF, then a jumper should be added from CS14 to the disables; the 2 memory chips at CS14 could then be removed. A table is attached which shows the chip select signal corresponding to a given address. Note that the segment disable jumper does not change even if the board address is changed.

## BANK SELECT

Provision is made for 8 bank select signals on S100 pins 14, 15, and 61-66. Either an 8 position DIP switch or jumpers may be used to define the active bank.



BANK    0 1 2 3 4 5 6 7
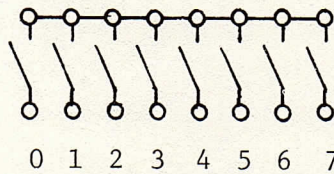
These lines directly define the active bank(s) by their DC state (rather than by pulses). These lines may be controlled directly from switches or from the forthcoming Problem Solver memory management feature.

## WAIT CYCLES

In the event that your computer is capable of operation at a faster rate than the Problem Solver board you have chosen, provision is made to synchronize the memory to the computer using the PREADYline of the S100 bus. Switch S1 positions 5 and 6 select the wait state by being placed in the "1" state:

|  | Switch 1 | |
| Provision | 5 | 6 |
| 0 wait states | x | 0 |
| 1 wait states | 0 | 1 |
| 2 wait states | 1 | 1 |

## SOL "PHANTOM"

The SOL system requires that the first block of memory be disabled for the first few machine cycles after power up to allow the monitor to initialize the system.

The RAM16 is disabled by means of the "PHANTOM" signal on pin 67 of the bus. This feature may be incorporated on the RAM16 by placing Switch 1, position 7 in the "0" state. It is disabled by placing the switch in the "1" state.

## TESTING

Each RAM16 memory board undergoes a thorough testing program consisting of a 40 hour burn-in with power on followed by one-hour of a proprietary "Blitz test" which operates the boards at their maximum rate, and fails them if they make one error.

## WARRANTY

Problem Solver Systems, Inc. (PSS) warrants its products against defects in workmanship and material. If any failure, resulting from a defect in either workmanship or material, shall occur under normal and proper use within 365 days from the original date of purchase, such failure shall be corrected free of charge to the original purchaser by repair or, at the sole option of PSS, replacement of the defective part or parts. No charge shall be made for labor or services performed during said 365-day period, providing the product is brought to PSS or to an authorized PSS Service Center.

This warranty will not cover equipment should PSS determine that said equipment has been tampered with in any way, or damaged by accident, negligence, alteration, or misapplication.

All equipment requiring service (whether under warranty or not) should be reported to your distributor, who will either suggest an authorized PSS Service Center or obtain authorization for you to send it to PSS. Equipment must not be returned to PSS until written authorization is secured. Equipment must then be returned transportation prepaid, properly packed, and insured. This warranty applies only to the original purchaser. NOTE: Warranty does not cover subsystems or portions of systems not manufactured by Problem Solver Systems, Inc.

## OUT OF WARRANTY SERVICE

Problem Solver Systems, Inc. services everything sold promptly and at a reasonable cost. If a product requires service, return it postpaid and it will be tested promptly.

You will then be advised of the repair cost either by phone (if you include your number) or by postcard. The minimum repair fee is $7.50. Repair and shipping require one working day after approval.

RAM16 16K x 8 SCHEMATIC
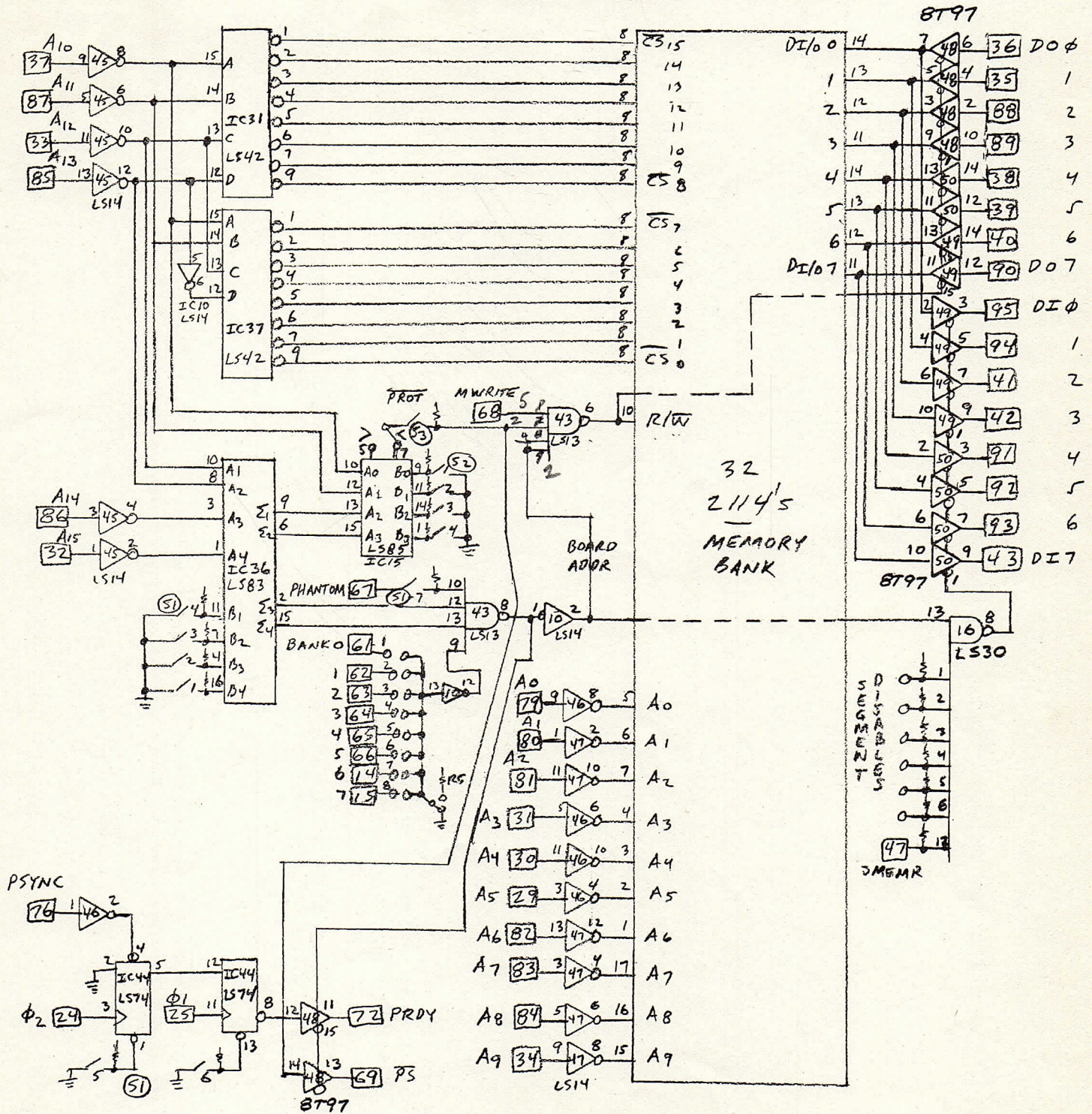
RAM16 CHIP LAYOUT
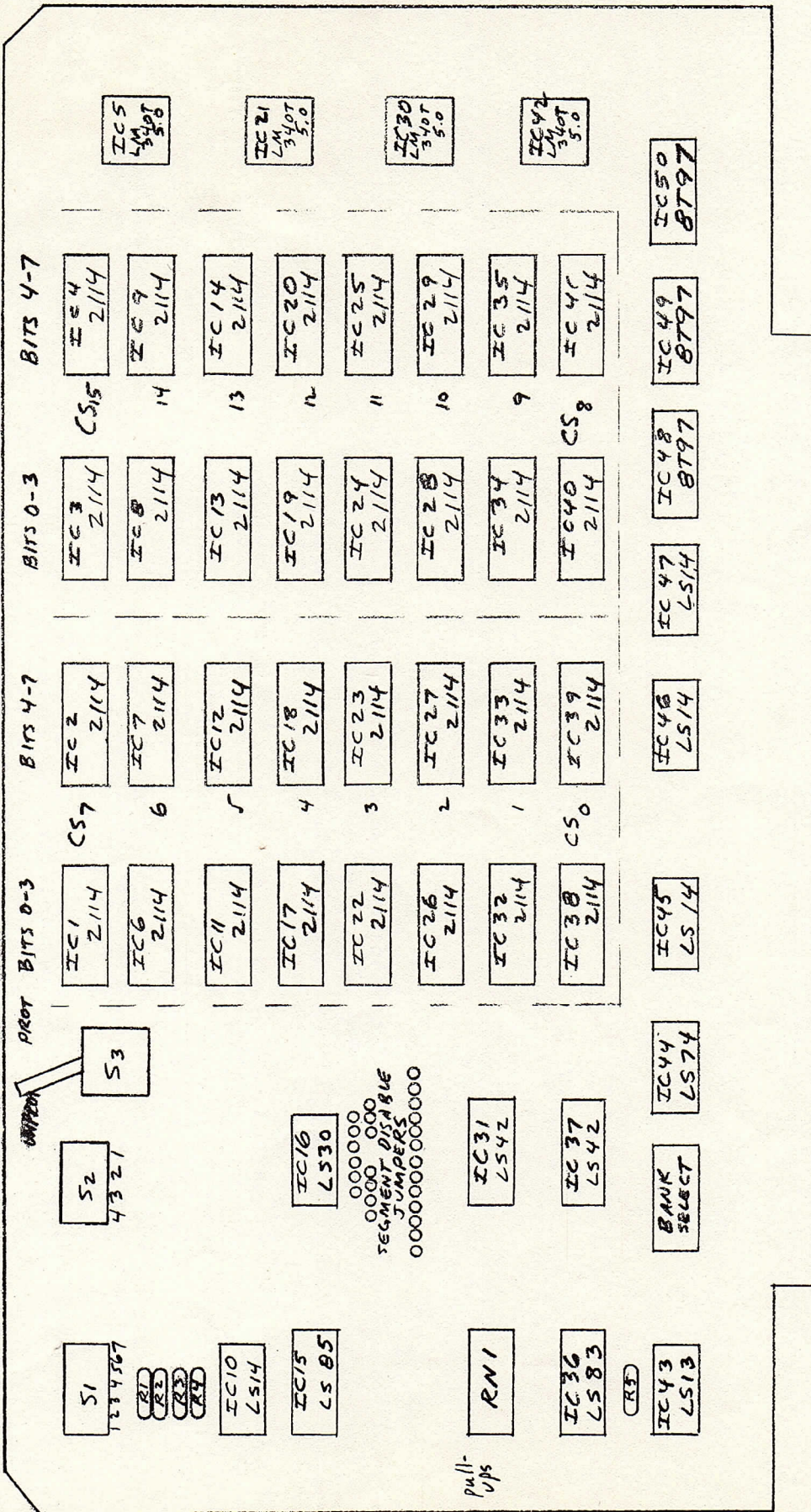
## CHIP SELECT VS. ADDRESS

Board Address

| Chip Select | Addr. Lines Select 13-10 | 0000 | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | A000 | B000 | C000 | D000 | E000 | F000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000 | 0000 | 4000 | 4000 | 4000 | 4000 | 8000 | 8000 | 8000 | 8000 | C000 | C000 | C000 | C000 | 0000 | 0000 | 0000 |
| 1 | 0001 | 0400 | 4400 | 4400 | 4400 | 4400 | 8400 | 8400 | 8400 | 8400 | C400 | C400 | C400 | C400 | 4000 | 4000 | 4000 |
| 2 | 0010 | 0800 | 4800 | 4800 | 4800 | 4800 | 8800 | 8800 | 8800 | 8800 | C800 | C800 | C800 | C800 | 8000 | 8000 | 8000 |
| 3 | 0011 | 0C00 | 4C00 | 4C00 | 4C00 | 4C00 | 8C00 | 8C00 | 8C00 | 8C00 | CC00 | CC00 | CC00 | CC00 | C000 | C000 | C000 |
| 4 | 0100 | 1000 | 1000 | 5000 | 5000 | 5000 | 5000 | 9000 | 9000 | 9000 | 9000 | D000 | D000 | D000 | D000 | 1000 | 1000 |
| 5 | 0101 | 1400 | 1400 | 5400 | 5400 | 5400 | 5400 | 9400 | 9400 | 9400 | 9400 | D400 | D400 | D400 | D400 | 1400 | 1400 |
| 6 | 0110 | 1800 | 1800 | 5800 | 5800 | 5800 | 5800 | 9800 | 9800 | 9800 | 9800 | D800 | D800 | D800 | D800 | 1800 | 1800 |
| 7 | 0111 | 1C00 | 1C00 | 5C00 | 5C00 | 5C00 | 5C00 | 9C00 | 9C00 | 9C00 | 9C00 | DC00 | DC00 | DC00 | DC00 | 1C00 | 1C00 |
| 8 | 1000 | 2000 | 2000 | 2000 | 6000 | 6000 | 6000 | 6000 | A000 | A000 | A000 | A000 | E000 | E000 | E000 | E000 | 2000 |
| 9 | 1001 | 2400 | 2400 | 2400 | 6400 | 6400 | 6400 | 6400 | A400 | A400 | A400 | A400 | E400 | E400 | E400 | E400 | 2400 |
| 10 | 1010 | 2800 | 2800 | 2800 | 6800 | 6800 | 6800 | 6800 | A800 | A800 | A800 | A800 | E800 | E800 | E800 | E800 | 2800 |
| 11 | 1011 | 2C00 | 2C00 | 2C00 | 6C00 | 6C00 | 6C00 | 6C00 | AC00 | AC00 | AC00 | AC00 | EC00 | EC00 | EC00 | EC00 | 2C00 |
| 12 | 1100 | 3000 | 3000 | 3000 | 3000 | 7000 | 7000 | 7000 | 7000 | B000 | B000 | B000 | B000 | F000 | F000 | F000 | F000 |
| 13 | 1101 | 3400 | 3400 | 3400 | 3400 | 7400 | 7400 | 7400 | 7400 | B400 | B400 | B400 | B400 | F400 | F400 | F400 | F400 |
| 14 | 1110 | 3800 | 3800 | 3800 | 3800 | 7800 | 7800 | 7800 | 7800 | B800 | B800 | B800 | B800 | F800 | F800 | F800 | F800 |
| 15 | 1111 | 3C00 | 3C00 | 3C00 | 3C00 | 7C00 | 7C00 | 7C00 | 7C00 | BC00 | BC00 | BC00 | BC00 | FC00 | FC00 | FC00 | FC00 |

Shows the chip select that will be activated for a given address. For example, if the board address is 1000 and the actual address is between 4000 and 43FF, CS0 will be active. Notice also that a given address will always result in the same CS, thus simplifying board disable.