SYM and AIM Memory Expansion

An easy hardware modification addresses extended memory in contiguous 8K blocks with no gaps. This neat enhancement makes Memory Plus a natural for RAM-ming more data into the SYM and AIM.

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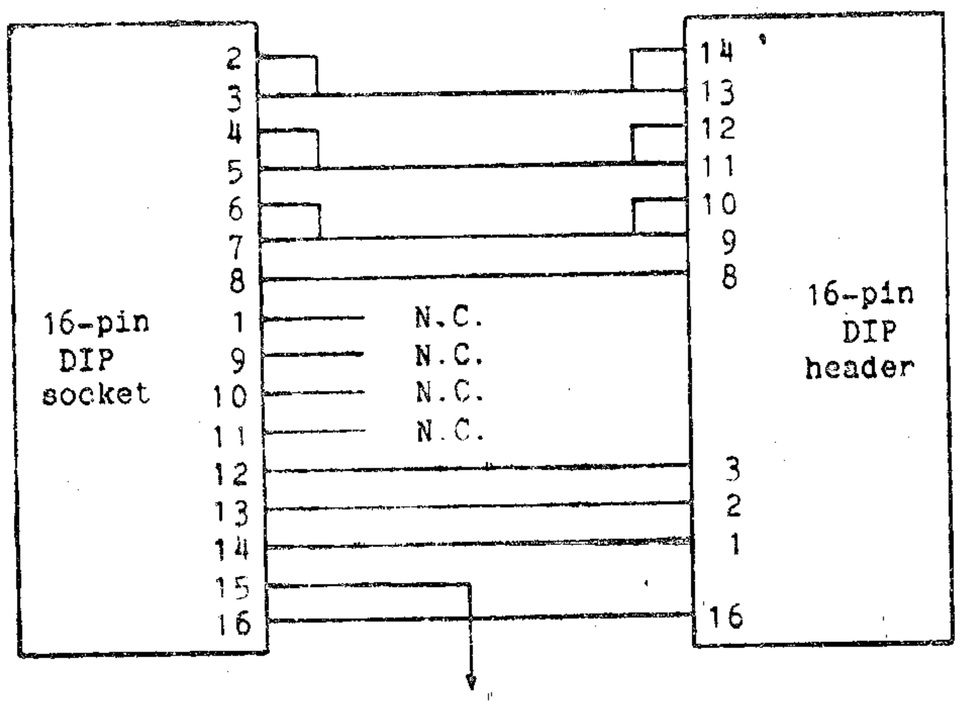
In an attempt to implement BASIC on the SYM it became apparent that the 4K of onboard RAM was insufficient for our needs. Although we have several Memory Plus boards around, the RAM on these boards is addressable in 8K byte blocks decoded at 8K boundaries, beginning at location 2000. Unfortunately, this decoding scheme leaves a 4K block of memory unimplemented. That block of memory is from address 1000 through 1FFF.

In order to overcome this shortcoming, it is desirable to decode the Memory Plus board in 8K blocks that are addressable at 4K boundaries; that is, at locations 1000, 3000, 5000, etc. With this scheme several MP boards could be added on to expand the SYM memory in a continuous fashion. There are methods available for making this change, but most of these require changes on the MP board itself. This is undesirable, especially if servicing becomes a problem.

The solution lies in replacing the three high order address line decoding schemes with one that will address memory at 4K boundaries. This can be accomplished by bringing addresses A12, A13, and A14 into the inputs of the 74LS138, as opposed to the present A13, A14, and A15. With this change any position of the rotary switch which selects the RAM decoding address enables the RAM at 4K boundaries, and also only in 4K blocks.



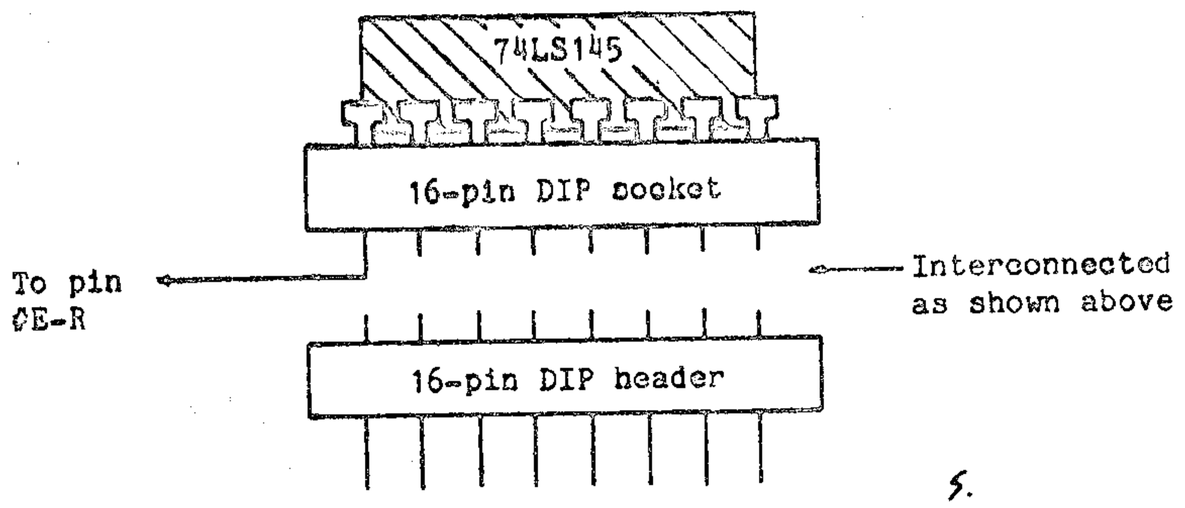
Solder to pin #E-R on the Memory Plus Expansion Connector

Figure 1

If we were to OR two adjacent outputs together, we would have 4K boundaries with 8K blocks. However, because the outputs of a 74LS138 are totem-pole, ORing them must be done with additional gating and not simply by tying the outputs together, as is done with open-collector outputs.

One method of doing this is by replacing the '138 with a 74LS145 BCD-to-decimal decoder driver. This device has open collector outputs enabling them to be wire OR'ed together. However, the pin out on the '145 is radically different from that on the '138.

The way to get around this is to mount the '145 in a 16 pin dip socket which is in turn connected to a 16 pin dip header. However, rather than matching the pins number for number, the connection diagram in Figure 1 is followed. This is most easily accomplished by using a three level wire-wrap socket and cutting short all the pins except 8 and 16. These shortened pins are then wired to the correct position on the header by soldering jumpers on. This causes the pin out connections to be changed and thus allows the '145 to operate in the socket which was previously loaded with the '138.



Remove the 74LS138 from socket U4 on the MP board and replace it with the above assembly

Figure 2

The 16 pin dip header is then loaded into the MP board into socket U4 as shown in Figure 2. The '145 has the advantage of having four address input lines. Thus address lines A12, A13, A14, and A15 are brought into it and fully decoded. Since address line A12 is not brought to socket U4, it must be separately wired. A convenient place to make this connection is on the MP expansion connector pin #E-R.

With these changes, the RAM select rotary switch now selects hex locations 1000-2FFF at the first two positions. At the second two positions RAM is selected at 3000-4FFF. In the third two positions RAM is selected at locations 5000-6FFF. RAM will not be selected with the selector switch in the seventh position.

With the switch in the first or second position, BASIC on the SYM can be implemented with 12K memory; the 4K onboard, plus the 8K from the MP. The addition of another MP board set up the same way with the RAM selection switch in either position 3 or 4 would yield a system with 20K of continuous memory.