# THE DIGITAL GROUP 8K x 8 RAM MEMORY CARD

This PC Board provides a low-cost means by which the hobbyist or small commercial user can increase the RAM in his microprocessor system. Up to 8K bytes in 1K byte increments are contained on a single card. On board address decoding permits up to 8 boards to be operated in parallel for a maximum of 65K. ROM and/or I/O addresses overlap are permitted by including RAM address degating circuitry. A single TTL load is presented to the driving address bus and write strobe with direct input and output from the RAMs. Write pulse inversion/buffering is provided.

Customizing possibilities are made easier by providing a considerable number of uncommitted connector pins. Address or Byte organization may be modified to support 4 bit, 12 bit, or 16 bit wide microprocessors within a single card for a 16K nibble or a 4K word card. Customizing capabilities of the Digital Group are available to large quantity users.

## Theory of Operation

The 2102 static RAM or equivalent is the central component. 1024 different data addresses may be accessed by controlling the voltage at 10 address inputs to each IC. In addition, Chip Enable will select a given IC from other 2102s - individual or tied together. Banks of IC's are operated in parallel to obtain the required number of bits in each byte or word.

The Digital Group 8K x 8 RAM board uses up to 64 2102's. All 64 2102's share the same addresses and are driven in parallel so that the "outside world" sees this board's address lines as a single TTL load. The 64 2102's are subdivided into an 8 x 8 memory matrix. You will notice that the IC's are numbered IC00 - IC77. The lastmost digit identifies the bit position within each 1K bank and the more significant digit identifies which of 8 banks this bank belongs to. Each input pin and output pin for a given bit position are connected in parallel. Typically, the outside world sees a full 8K board as 1/20 TTL load with 24 pfd load on each input pin. The outputs typically represent a total of 56 pfd on each output with a capability of driving slightly over 1 standard TTL load.

A given bank of 8 2102's (one for each bit position) is addressed by making its Chip Enable (CE) go low. The combination of the 10 address lines and $\overline{CE}$ will read the data at each of the eight 2102's in the bank if the Read/Write line (pin 3) is high. Changing the 10 address lines to their 1024 different combinations will result in the 1024 bytes of data being outputted to the microprocessor. Reading the data does not change the 2102 contents in any way.

If the Read/Write line is brought low after an address has been selected, the data at the input is transferred (written) to the selected address for later usage. The Read/Write line is sent to



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all 64 2102's. However, data writing will only take place in that bank whose CE is brought low.

A key operation is obviously bank selection. Since the board can be set to any of 8 positions in 65K, a 7404 (IC82) and 1/2 7420 (IC84) are used to make the logic assignment. The ROM time disable is also inputted to the 1/2 7420 gate. If this board is to be selected, then all inputs of the 1/2 7420 must go high, forcing the output low, permitting a 0 - 7 bank decode from the 7442 (IC83).

Certain applications may require pullup resistors to +5V on the address and data lines, so convenience holes are drilled on the board for mounting the resistors if required. Most applications, such as the Digital Group Systems, do not require any resistors.

Construction

Tools: Fine-tipped, low wattage soldering iron
"Wire solder" (22 guage resin solder)
Small diagonal cutters

Test Equipment: Ohmmeter
10MHz or better triggered sweep Osciloscope helpful
Microprocessor

Estimated Construction Time: 1-1/2 to 5 hours

1. Insert the 65 16-pin IC sockets for the 2102's and 7442. If the sockets have a keyway indication, orient this away from the connector. Note - the top side of the board is indicated by the Digital Group label.

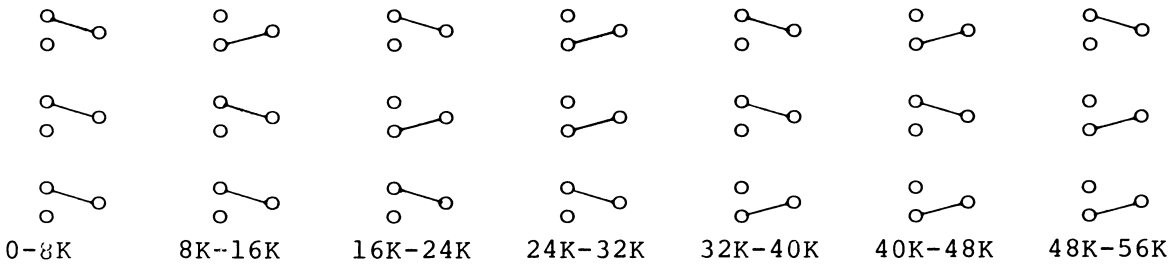
2. Insert the four 14-pin IC sockets for the 7420 and three 7404's oriented away from the connector if indicated.

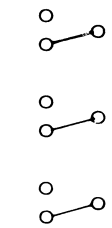
3. Invert the board and carefully solder in the sockets. A special plating process is used by the Digital Group to minimize solder joint troubles. We would suggest a "warmup area" by starting on the middle decode area before attempting the fine memory areas of the board.

It is surprisingly easy to overlook soldering pins in a board of this type. Sighting down rows and columns of pins will usually find these missing joints, which are generally the end pins on a socket.

4. Connect the jumpers according to your needs. The space under the 7420 is used for jumpering. The 3 three-pad blocks on the left are used for 8K memory assignment. The bottom right three-pad block is used for write strobe polarity assignment. The three-pad block above the write-block, and the two pad block immediately above the three-pad are used for ROM time degate polarity assignment. If this ROM time etc. degate function is not required, use the $\overline{\text{ROM}}$ jumpering and tie pin 29 to +5V.

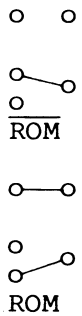
Board Memory Assignment



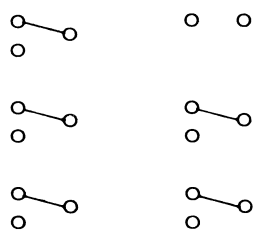




Write Strobe Polarity:


ROM/ I/O Time Degate:




The most common board jumper situation would be 8K at the bottom of memory (0 - 8K) with negative going ROM time ($\overline{\text{ROM}}$) and a negative going Write strobe ($\overline{\text{Write}}$). Using the above, the jumpers would be:



5. Insert the five .01 bypass condensers, one at each corner, and one at the power pins. Insert the 1 mfd solid tantalum at the power pins, + end (yellow) up. Holes for more bypassing capacitors have been provided should you feel that your particular application requires more bypassing.

6. At this point, you should measure a very high resistance between the supply pins 1 & 2. A low resistance indicates a shorted condenser, or perhaps a short between pins 9 & 10 of some 2102.

7. NOTE - All IC's are oriented with their keyed or pin 1 end pointing away from the connector end of the card. Insert the TTL IC's, the 7442, 7420, and three 7404's. Again measure between pins 1 & 2 on the plug. This time a lower resistance will be measured with one probe polarity and a higher resistance with reversed probe



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polarity. A short indicates a bad IC. Similar resistance with either polarity indicates a reversed IC.

8. You can proceed in two ways from this point.

   a. Plug in all 2102's and put the card into your microprocessor. (Often referred to as the "smoke test".)

   b. 1) Measure the resistance between all adjacent pins for solder bridges and eliminate if found.

      2) Plug in the card to a microprocessor or test unit to verify strobing and gating action (assuming this card is auxiliary memory). Look for a low (Ø) level at pin 13 of an addressed 2102.

      3) Plug in one 2102 and test for proper reading and writing action.

      4) Plug in one bank and test.

      5) Finally plug in all other 2102's.

9. Program the Microprocessor to repetitively write & test the memory. A copy of this software is included with the Digital Group Systems.

10. Large quantity users (300 or more boards) are invited to contact the Digital Group for any quotations for customizing the design of this board.

11. Warranty:

    Standard Digital Group Warranty applies. All Digital Group supplied parts are guaranteed for 90 days on an exchange basis. If you send the memory board back to us to fix, there will be a flat $10.00 fix-it service charge irrespective of the warranty period. Parts will be charged for units outside of warranty. Service charges should be pre-paid and included with the return of the kit for fastest service. Be sure to indicate the 8K area of 64K to be addressed as well as Write strobe and ROM degate (if used) polarities, or it will be impossible to completely service your board.

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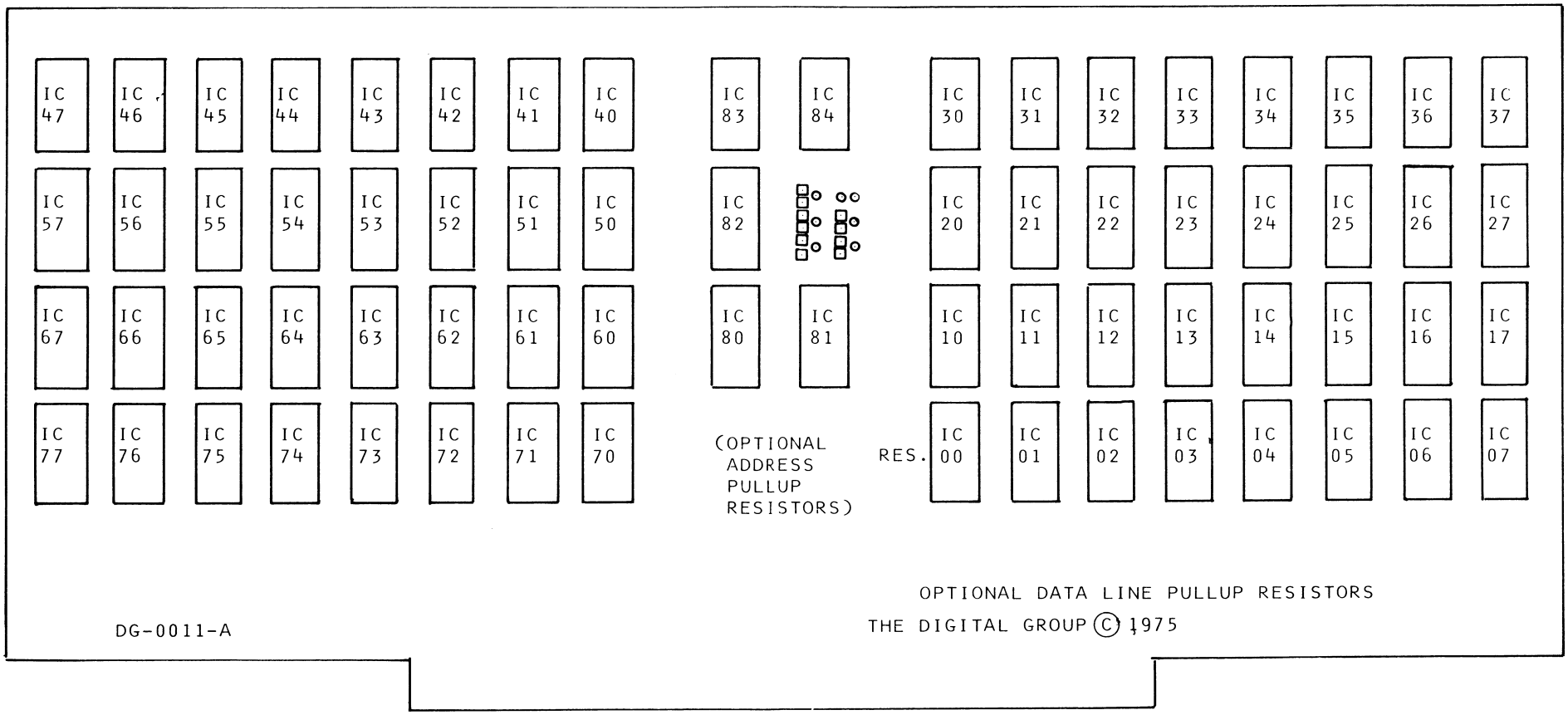
THE DIGITAL GROUP 8K X 8 RAM MEMORY CARD - COMPONENT LAYOUT

DGM-CL-R0




NOTE: 2102 IC NUMBERING:
MOST SIGNIFICANT DIGIT REFERS TO BANK POSITION. LEAST SIGNIFICANT DIGIT REFERS TO BIT SIGNIFICANCE.

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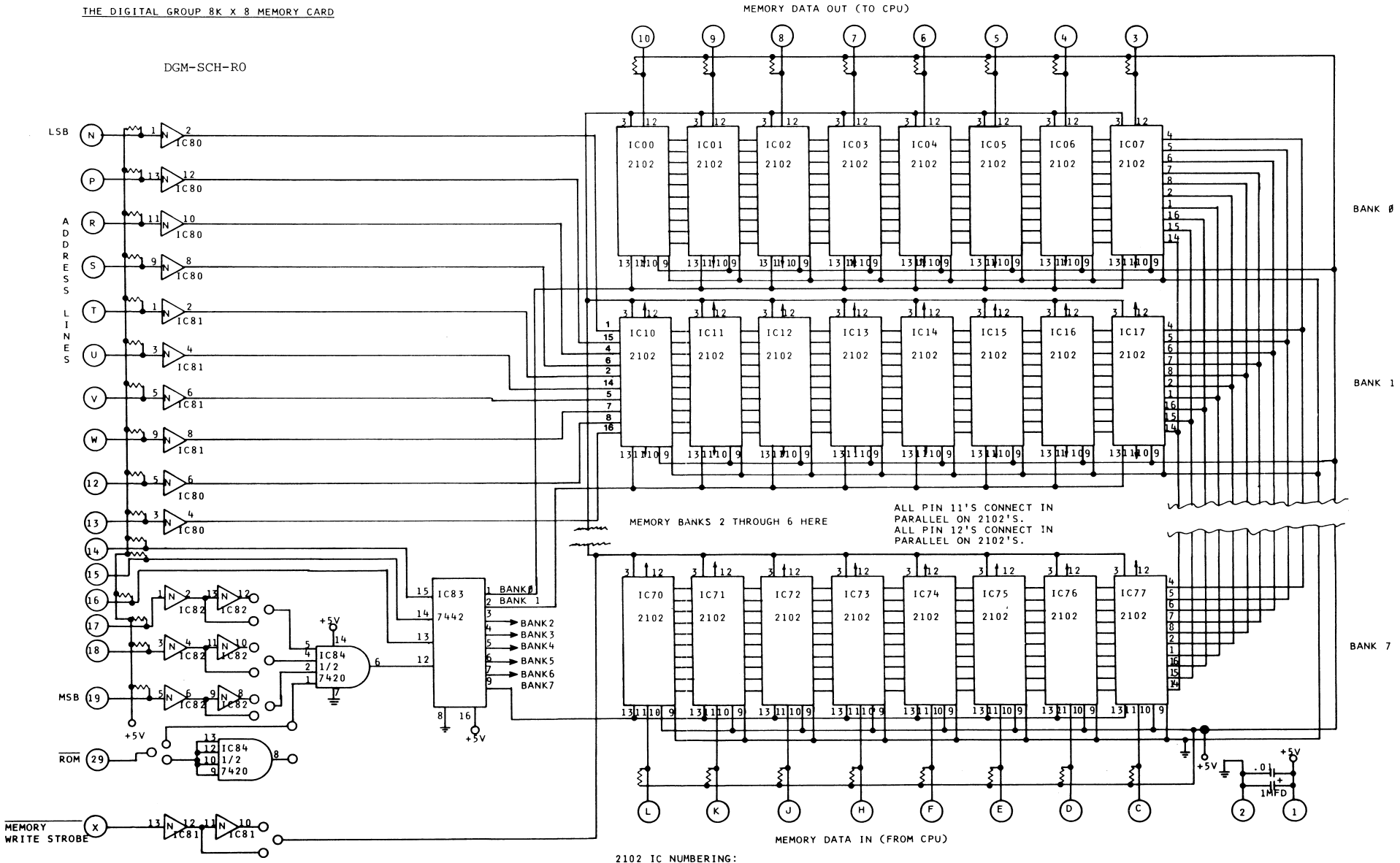
DGM-SCH-R0




NOTE: N = 1/6 7404
(+5V ON PIN 14,
GND ON PIN 7)

2102 IC NUMBERING:

MOST SIGNIFICANT DIGIT
REFERS TO BANK POSITION.
LEAST SIGNIFICANT DIGIT
REFERS TO BIT SIGNIFICANCE

NOTE: ALL PULLUP RESISTORS SHOWN ARE OPTIONAL AND ARE NOT REQUIRED FOR MOST APPLICATIONS.