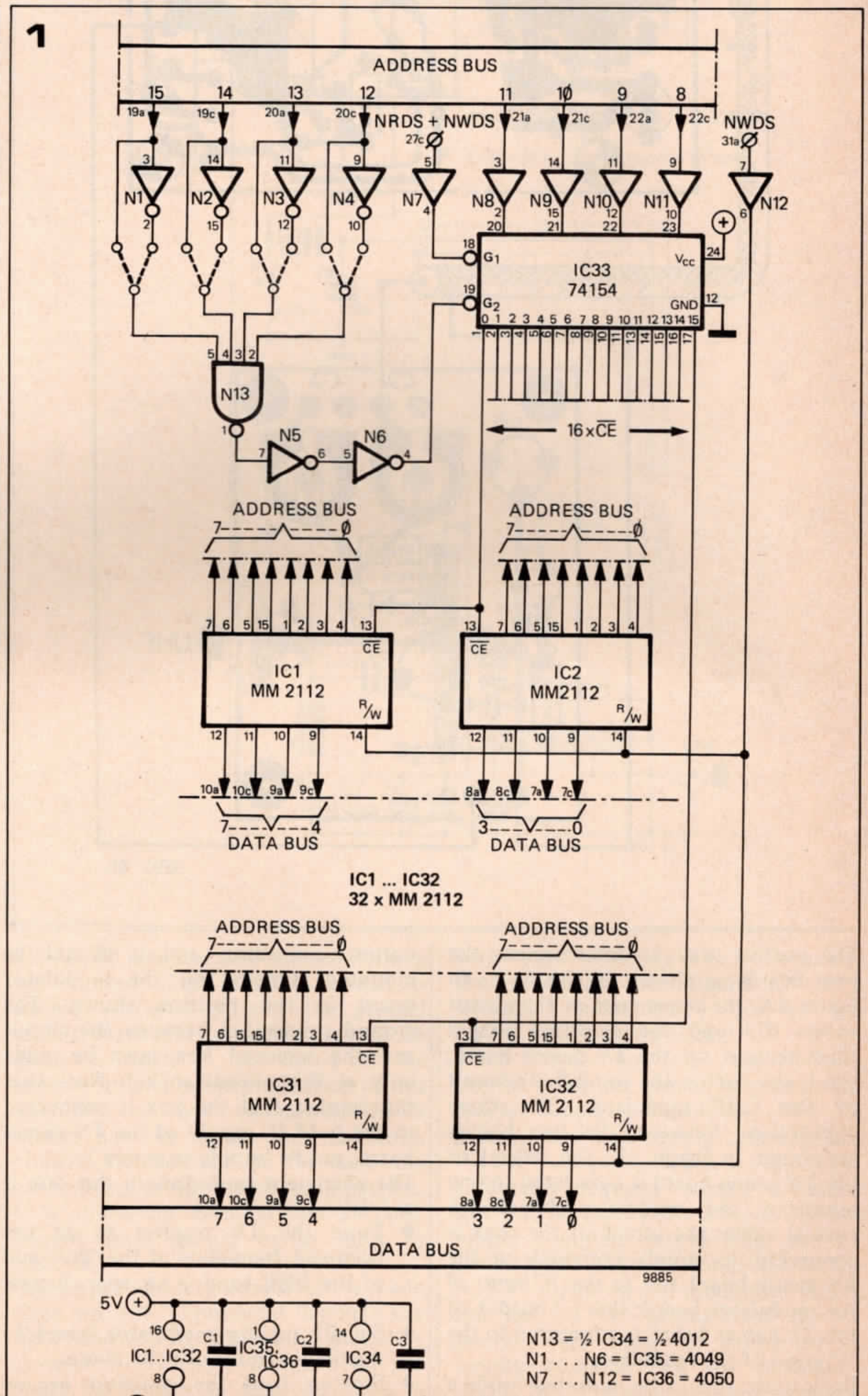
4-k RAM card

In order to expand the memory capacity of microcomputers use is often made of plug-in memory cards. The RAM card described in this article is primarily intended as an extension of the SC/MP system, however it can also be used with any 8-bit microprocessor.



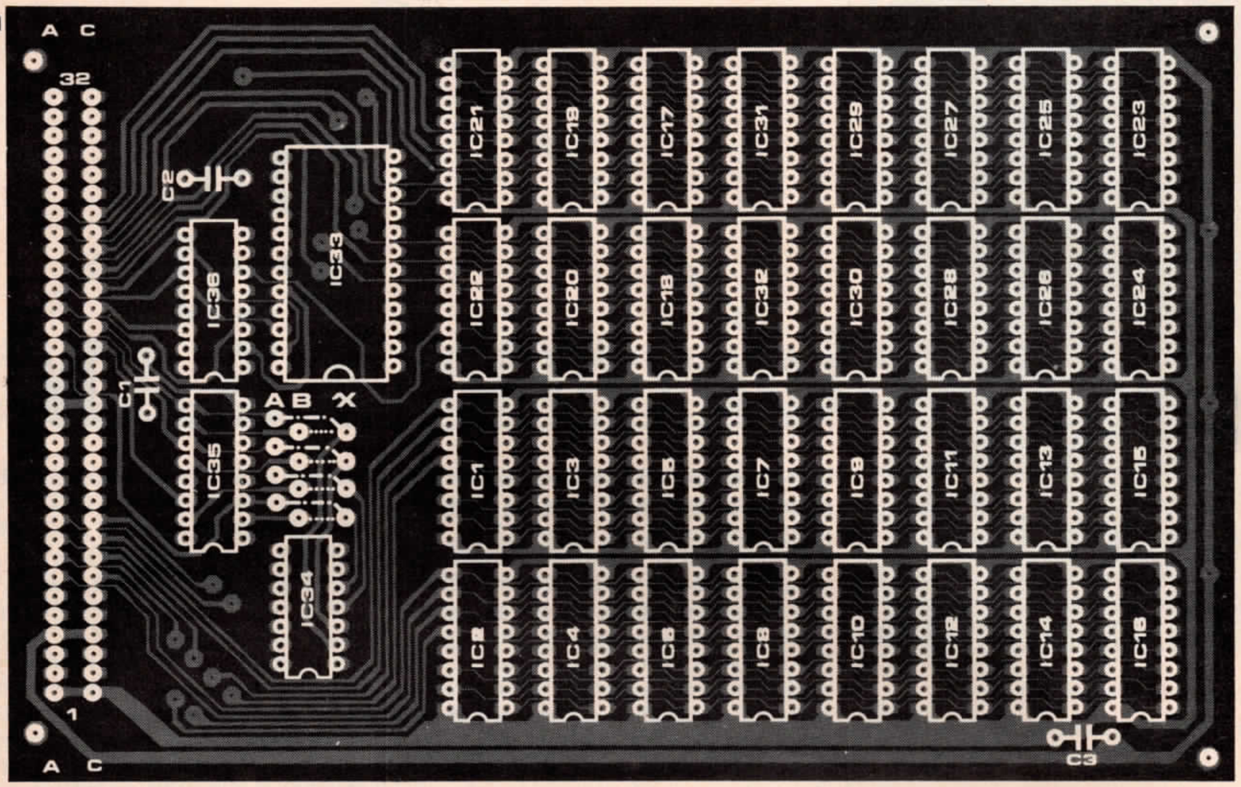
The memory card consists of up to 32 RAMS, type 2112. This is a 256 x 4 bit memory, i.e. to obtain a 4-k RAM (4096 x 8 bits) all 32 ICs would be required. The circuit diagram of the memory card (see figure 1) shows only the first two (IC1 and IC2) and last two (IC31 and IC32) RAMs. The chip-enable inputs of the RAMs are activated by the outputs of a binary to hexadecimal decoder (IC33) which functions as an address decoder. In order to reduce the loading on the address bus to a minimum, MOS buffers are used on the lines to the address decoder. Of the two chip-enable inputs of the address decoder (G1 and G2 of IC33), one is activated by the read- or write strobe (NWDS + + NRDS), the other by the four highest address bits. These four address bits, whether inverted or not, are fed to the NAND gate N13. In order to address the RAM card all four inputs of this gate must be at logic 1. If the address of the RAM card when used in a particular system is, e.g. 2ØØØ . . . 2FFF, that means that inputs 5, 4 and 2 of N13 should be connected to the outputs of N1, N2 and N4 respectively, whilst input 3 of N13 is connected direct to bit 13 of the address bus. Thus by altering the 'wiring' in this way the RAM card can occupy any desired page in memory.

The entire RAM card can be powered from a 5 V supply; the current consumption of the card is approx. 1 A.

Printed circuit board

A printed circuit board was designed to accommodate all the various com-

2a



2b

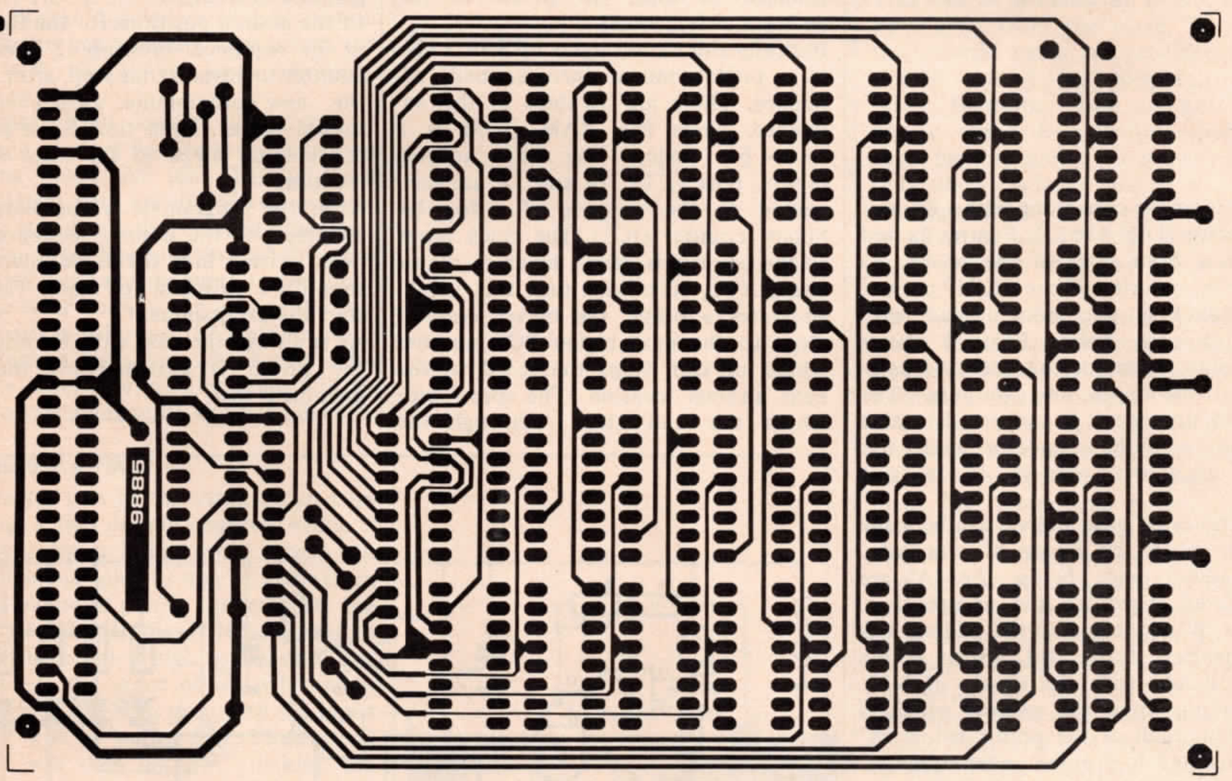


Figure 1. The circuit diagram of the 4-k RAM card. For the sake of clarity only four of the possible total of 32 RAMs are shown here.

Figure 2. The top (2a) and bottom (2b) sides of the printed circuit board for the RAM card (EPS 9885). The board conforms to Eurocard dimensions.

Parts list

Semiconductors:
IC1 . . . IC32 = 2112 (National, Intel, Texas Instr. etc.)
IC33 = 74154
IC34 = 4012
IC35 = 4049
IC36 = 4050

Capacitors:
C1 . . . C3 = 100 . . . 150 n

Miscellaneous:
DIN 41612 connector (64 way, 3 rows, rows A and C loaded)

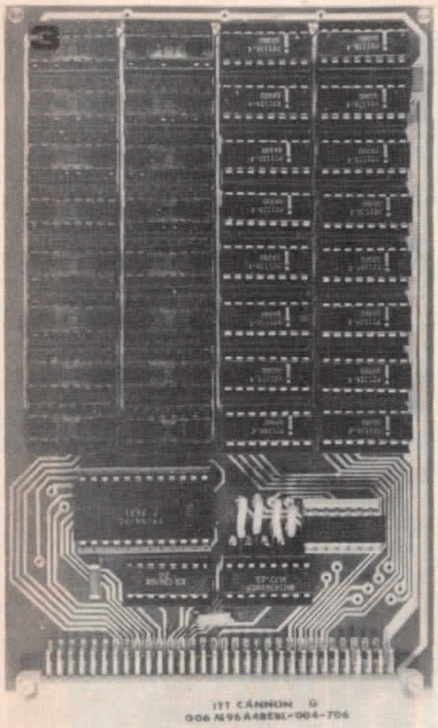


Figure 3. The RAM card housing 2 k of RAM.

ponents on the card along with a 64 way connector (DIN 41612). Figures 2a and 2b show both sides of the board. As with the majority of the SC/MP p.c.b.s, this board is also double-sided with plated-through holes. Figure 1 shows the connections for the address-, data- and strobe-inputs and outputs. The positive supply rail is connected to pins 1a and 1c of the connector, whilst the earth rail goes to pins 4a, 4b, 16a and 16b.

The choice of page address can be made on the board by means of wire links. The solder pads below the 'A' are connected direct to the address bus. Points 'B' connected to the address bus via inverters N1 . . . N4, whilst points 'X' coincide with the inputs of N13. Depending upon the address which is required, each of the points below 'X' is connected to a point under either 'A' or 'B'.

Finally, figure 3 shows a prototype of the card. As is apparent from the photograph, the card need not be completely filled with RAMs, since it is unlikely that such an extensive memory will prove necessary (to say nothing of the cost involved).

With 16 RAMs, the card in figure 3 represents a 2 k memory. It is possible to fill the card in steps of 1/4 K. The only point to notice is that the numbering of the memories shown on the component layout should be adhered to.

fun with a RAM

(M. de Bruin)

The following circuit is intended as a simple illustration of how to interface peripheral 'hardware' with a RAM.

Random Access Memories (RAMs) are usually used in microprocessor applications where the data to be stored must be changed or modified easily. Static RAMs, like the one used in this circuit, use the inherent storage capability of a bistable device such as the flip-flop. A static RAM will store information until the information is changed or until the power to the device is switched off.

Basically this circuit lights up four LEDs in a predetermined (programmed) sequence. There are 16 steps in this sequence, since the RAM (IC3) is a 16 x 4 bit device. The BCD address inputs, pins 1, 13, 14 and 15, are connected to the outputs of a four-bit binary counter (IC2). The clock input to the counter is driven by an oscillator circuit (T1, N1). Each time this 'clock' generates a pulse, the binary counter steps to the next higher BCD number which in turn steps the RAM to the next address location. The speed with which the unit steps through the address locations is determined by the clock frequency; this can be adjusted by P1. The RAM outputs are open collector and hence can drive the LEDs directly.

To programme the RAM, switch S1 is put in the 'write' position. The new programme is determined by the setting of switches S4 . . . S7. A binary one ('1') corresponds to an open switch, due to the pull-up resistors R7 . . . R10.

When S3 is pressed the binary counter is reset to zero (BCD: ØØØØ). The programme switches S4 . . . S7 are now set to the desired positions for the first step in the sequence. Pressing S2 causes the counter to advance one step, after which the new programme switch settings should be set. Each time S2 is pressed the counter steps to the next address location.

After the programme is completed (all 16 steps of the desired sequence have been written into the RAM) switch S1 should be switched to 'read'. This will start the programme.

As is always the case with RAMs, when the power is switched off the programme is lost.