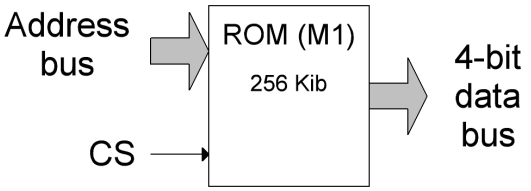
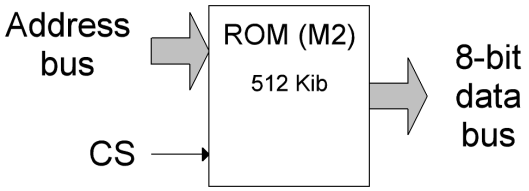
Tutorial 3
Memory Devices

Exercise 1

Let us consider the two following ROM devices:





1. How many 4-bit words does the memory device **M1** contain?
2. How many 8-bit words does the memory device **M2** contain?
3. How many address lines does each of the two memory devices have?

A memory device **M2** should be built from two memory devices **M1**.

4. In which way should the memory devices be connected to each other?
5. Draw the circuit diagram.

Exercise 2

A RAM device (**M1**) has a capacity of 2 Mib, a 4-bit data bus, a *CS* input and a *WE* input. A RAM device (**M2**) has a capacity of 4 Mib. The data and control buses of these two RAM devices are identical. A memory device **M2** should be built from several memory devices **M1**.

1. Work out the number of address lines for each of the two memory devices.
2. In which way should the memory devices be connected to each other?
3. How many address lines are required to control the *CS* input of each memory device **M1**?
4. Draw the circuit diagram.
5. Which memory device **M1** is selected when the address 515_{10} is being read?
6. Which memory device **M1** is selected when the address $9A844_{16}$ is being written?

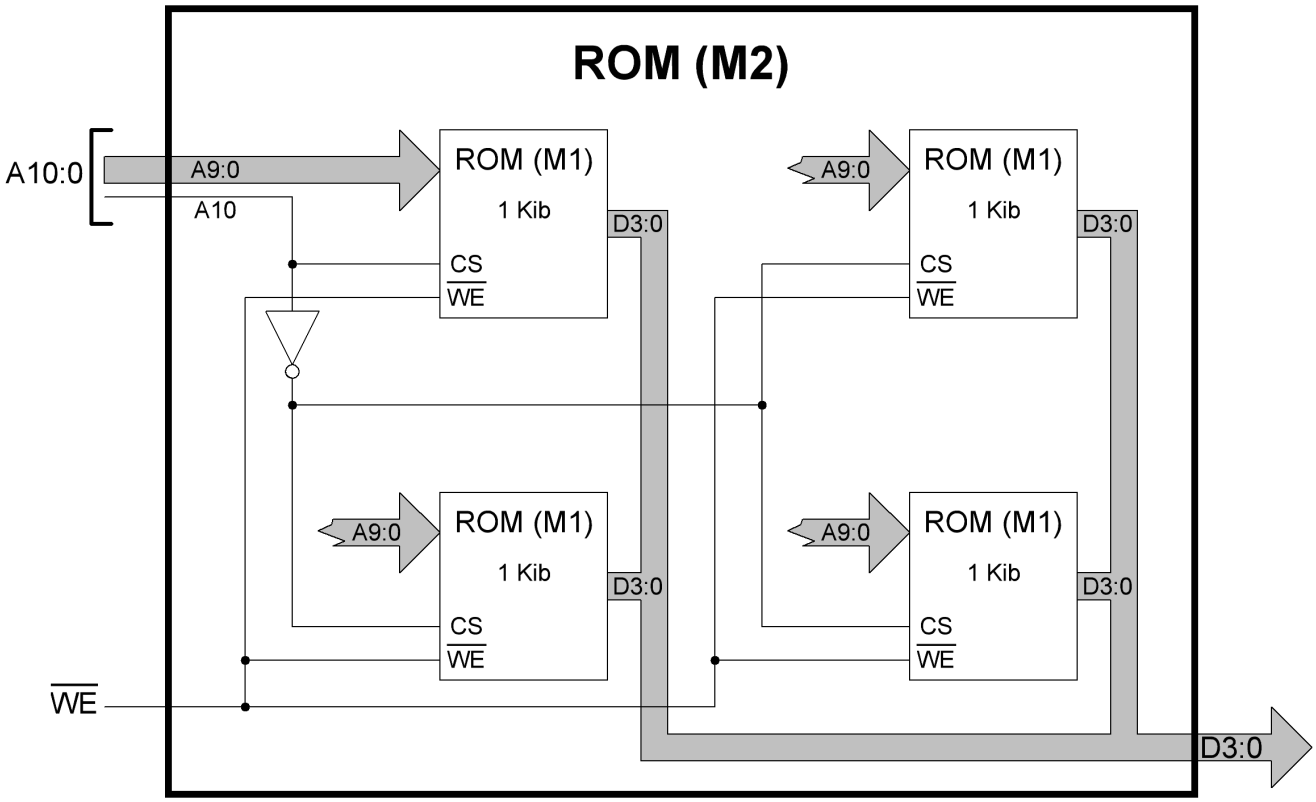
Exercise 3

A RAM device (**M1**) has a capacity of 512 bytes and a 4-bit data bus. A RAM device (**M2**) has a capacity of 8 KiB and a 16-bit data bus. A memory device **M2** should be built from several memory devices **M1**.

1. Work out the number of cells and the size of the address bus for the two memory devices.
2. How many memory devices should be put in series?
3. How many memory devices should be put in parallel?
4. How many address lines are required to control the *CS* input of each memory device **M1**?
5. Draw the circuit diagram.
6. Which memory devices **M1** are selected for each of the following addresses: $95A_{16}$, $E03_{16}$, $1FF_{16}$, 725_{16}.

Exercise 4

The memory device below has a few mistakes. Find them and correct them.



Indications :

- The number of memory devices **M1** is right.
- The capacity (in bits) of the memory device **M1** is right.
- The size of the data bus of the memory device **M1** is right.
- Parallel connections are displayed horizontally.
- Series connections are displayed vertically.
- They are ROM devices.