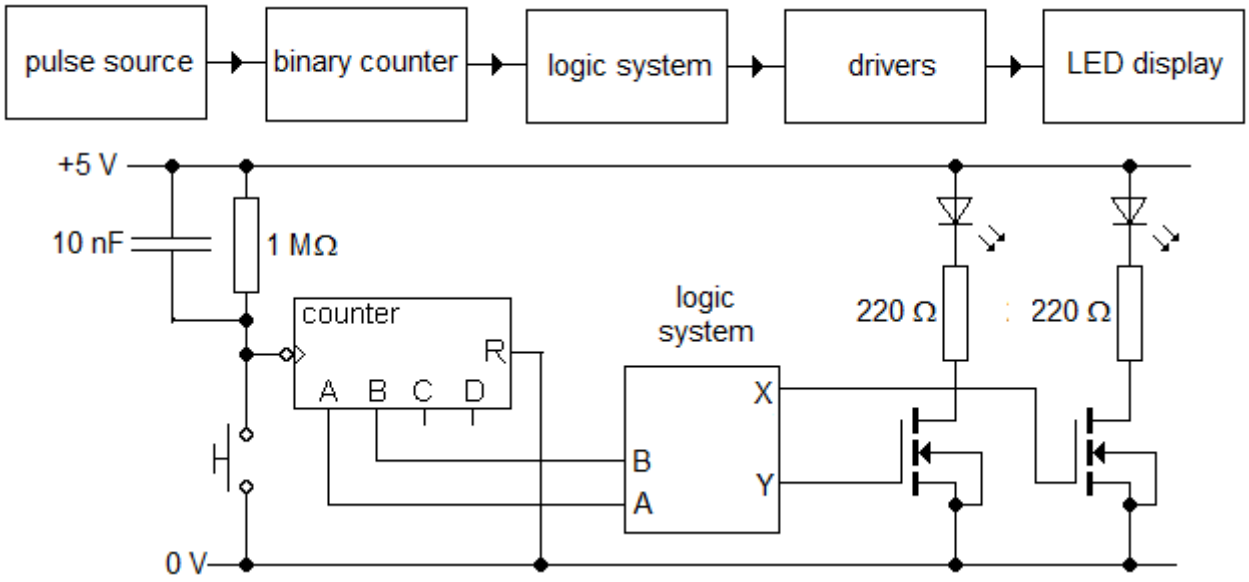
Gray code

You are going to design a system which counts up in a two-bit Gray code. Here is a block diagram for it. The system has to count pulses as shown in the table.

pulse	X	Y
0	0	0
1	0	1
2	1	1
3	1	0

Here are the block and circuit diagrams.



1 Complete the truth table for the logic system.

B	A	X	Y
		0	0
		0	1
		1	1
		1	0

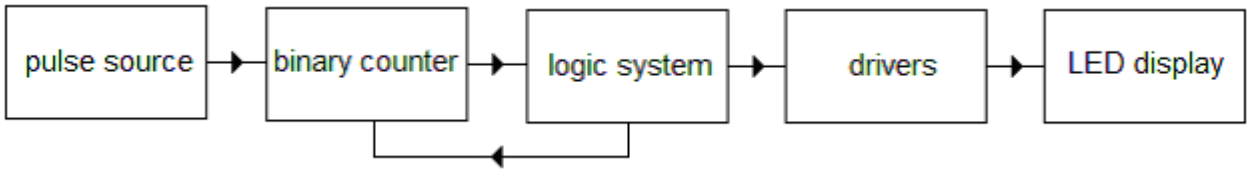
2 Write down Boolean algebra expressions for X and Y in terms of B and A. Use them to design the logic system.

3 Assemble the system and verify that it operates as required.

4 Replace the pulse source with an oscillator so that the system continuously cycles through its ouput states, spending 2 s in each state.

One, two, three

You are going to design some continuous sequencers.



1 The first sequencer has three LEDs as its output. Each has a different colour. The sequence of output states is shown in the table. Each state lasts for 1 s.

state number	glowing LEDs
0	none
1	red
2	red & yellow
3	red & yellow & green

2 Assemble a 1 Hz relaxation oscillator. Use an LED, 220 Ω resistor and driver to verify that it has the correct frequency.

3 Add the counter, with R held at 0 V. Leaving room for the logic system, add the drivers and LED display. Use the LEDs to verify that the counter is operating correctly.

4 Design the logic system. Assemble it and verify that the system operates as required.

5 Adapt the system so that it behaves as shown in this table, with each state lasting 5 s.

state number	glowing LEDs
0	red
1	yellow
2	green